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The Institute of Vitreous Enamellers
The Welsh Engineers' and Founders' Association
and
The Foundry Trades' Equipment and Supplies Association

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Trade Associations

Trade associations have become a recognised part of the business organisation in Great Britain, but their status and functions have not been clearly defined. What they are and what they should do formed the subject of a Paper by Mr. Tudor Davies before the Royal Society of Arts. Mr. Davies began by describing the trade association as the instrument of democracy for co-ordination in industry, and he distinguished associations in the free countries from those set up in the totalitarian States. Mr. Davies believes that trade associations in their various functions give earnest of the new spirit of co-operation and willingness to help one another without which the rehabilitation of British industry cannot be achieved. They prepare the way for those larger economic units, designed to secure the minimum of waste of either effort or material, the scientific organisation of labour, standardisation of material and products, simplification of processes and improvements in the system of transport and marketing.

A generation or so ago, combinations of most kinds were looked upon with a certain suspicion; under the influence of the Manchester School of individualistic theory, British industry was left to develop along its own lines, free from interference from the legislature, the executive and the judiciary. This old spirit of freedom, however, acted as an obstacle to the co-operation and centralisation which British industry needs to-day. Nevertheless, trade associations are not really opposed to English ideas; in fact, a Commission sent to this country last year by President Roosevelt reported that they are calculated "to call forth patience, understanding and the desire to make and keep agreements and achieve industrial peace."

Mr. Davies enumerates the activities of a trade association; its first object is to stabilise both price and production, but its work does not end there; its leaders must look forward and formulate a policy for the betterment of the industry as a whole. He insists that members of trade associations must practise the principles of price maintenance when they are buyers just as when they are sellers. From the national point of view, trade associations can be helpful by clearing away competitive redundancy. In the totalitarian States the interests of finance, industry and labour are fused; in democracies they can only be co-ordinated. Mr. Davies himself would go a good deal further, and suggests the creation of a department in which service departments and private enterprise would have equal representation. This would be administered by a Minister of Production with a committee drawn from the various interested bodies, *i.e.*, representatives of the service departments, trade associations and trade unions. By this means the co-ordination of Britain's resources in the interests of defence, domestic trade and export business could be consolidated. From Germany we have borrowed the name and the method of cartels, although in fact we had something of the kind in the trade guilds of the Middle Ages.

Cartels have proved to be necessary creations of modern economic life, and have grown out of circumstances which could no longer be allowed to continue. The formation of associations for the regulation of production, and for the keeping of selling prices within reasonable limits by the application of right measures, was bound to follow. Naturally enough, cartels are most likely to be formed and to prove their value in periods of depression, although, in the past, they have been threatened at such times by price-cutting on the part of certain members in order to secure business at the expense of the rest. Happily in recent years the tendency has greatly diminished as a result of more efficient organisation, and the introduction of more effective methods to deter those who may be tempted to snatch a temporary advantage.

Mr. Davies thinks the best cartel is undoubtedly the one which adapts production to demand, and has the greatest influence on the reduction of cost price, making ultimately both for success of the business and the satisfaction of the customer.

The only defect in the lecture was that time did not allow Mr. Davies to cover his subject completely—a defect which is remedied in his well-known book, "Trade Associations and Industrial Co-ordination." Here such subjects are included as statistics, research, standardisation, basic material or finished product development, exhibition policy, negotiation for equitable transport costs, and import duty levels. Some of these are, of course, essential for the maintenance of economic price levels, but, taking a long view, co-operative action for reinforcing the technical foundations of an industry is the most important.

The Aachen Colloquium

The eighth Winter Colloquium of the Aachen Foundry Institute of the Technical Higher Grade School is to be held on February 16 and 17. The meetings are to be held at the Nauman Institute, No. 1, Intzestrasse, Aachen. The morning session of Thursday, February 16, is to be presided over by Dr. Haas, and the afternoon by Dr. Nipper, and the following Papers are to be presented.

(1) "French Research Work on Light Alloy Castings," by Professor A. Portevin.

(2) "New Developments in Light-Alloy Casting Production in Germany," by Mr. A. Beck.

(3) "Swiss Research into Aluminium Stick Casting," by Professor A. von Zeelander.

(4) "Technical Properties at Elevated Temperatures of Cast Light Alloys," by Professor E. Schmid.

(5) A Paper by Mr. H. Rôhrig.

(6) "Research Using a New Type of Electric Melting Furnace," by Mr. Gengenbach.

(7) "Note on the Crystallisation of Quasi-Eutectic Alloys," by Mr. W. Patterson.

(8) "Testing and Inspection of Light-Alloy Castings," by Mr. W. Bungardt.

(9) "Influence of Superheating on the Mechanical Properties of Cast Magnesium Alloys," by Mr. K. Achenbach.

(10) "Solubility of Hydrogen in Aluminium and Magnesium," by Dr. Winterhager.

(11) "Technical Training and Education," by Dr. H. Nipper.

The next day, Friday, Dr. A. von Frankenberg u. Ludwigsdorf will preside over the morning session and Professor Piwowarsky over that held in the afternoon. The programme includes the following Papers:—

(12) "Practical Machining [or Sampling?] Based on Theory," by Dr. E. Lips.

(13) "Corrosion Resistance and Scale Properties of Cast Iron," by Dr. W. Patterson.

(14) "Rational Casting Design," by Dr. Bertschinger.

(15) "Recent Researches on the Graphitic Formation of Cast Iron," by Professor Piwowarsky.

(16) "Internal Stresses in Cast Iron," by J. E. Hurst.

(17) "New Investigations into the Superheating of Cast Iron," by Dr. A. von Frankenberg u. Ludwigsdorf.

(18) "Hot-Blast Cupola Practice Developments," by Professor Piwowarsky.

(19) "Work and Joy in the Foundry Institute" (with film).

A number of social functions have been arranged in conjunction with the meeting, and visitors from Great Britain will be welcome. No registration fee is payable.

Patent Specifications Accepted

The following list of Patent Specifications accepted has been taken from the "Official Journal (Patents)." Printed copies of the full Specifications are obtainable from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. each. The numbers given are those under which the Specifications will be printed and abridged, and all subsequent proceedings will be taken.

493,476. LUHR, F. A. Apparatus for cleaning tubes and like articles internally.

493,518. PFEIFFER, W., and VOOS, E. Production of metal coatings on stainless steel.

493,558. PASCHKE, M., and PEETZ, E. Production of pig-iron.

493,601. KRUPP GRUSONWERK AKT.-GES., F. Conveyor roller for rolling-mill feed-tables having individual electric drive.

493,610. STEWARTS AND LLOYDS, LIMITED, and DICKIE, H. A. Manufacture of low-phosphorus basic Bessemer steel.

493,629. JUHLIN, G. A., and METROPOLITAN-VICKERS ELECTRICAL COMPANY, LIMITED. Electrical driving equipment for rolling mills and the like.

Institute of Metals

The Thirty-First Annual General Meeting, Dinner and Dance of the Institute of Metals will be held on March 8-9 next at the Institution of Mechanical Engineers, Storey's Gate, Westminster, London, S.W.1 (by kind permission of the Council of the Institution). The Papers presented for discussion on March 8 will include the following: "Types of Creep Curve obtained with Lead and its Dilute Alloys," by J. N. Greenwood and H. K. Worner; "Annealing Characteristics and Solid Solubility Limits of Copper and Copper Alloys Containing Chromium," by W. O. Alexander; "The Elastic Properties of Some Anti-Friction Alloys at Room and at Elevated Temperatures," by J. W. Cuthbertson; "The Vapour Pressure of Zinc in Brasses," by R. Hargreaves; "The Influence of Static Stress and Heat-Treatment on the Intercrystalline Corrosion of Some Wrought Aluminium Alloys," by J. D. Grogan and R. J. Pleasance; "Embrittlement of Tin at Elevated Temperatures and its Relation to Impurities," by G. E. Homer and H. Plummer; "On the Theory of the Origin of Rolling Textures in Face-Centred Cubic Metals," by M. R. Pickus and C. H. Mathewson; "An X-Ray Investigation of Cobalt-Aluminium Alloys," by A. J. Bradley and G. C. Seager. On March 9 there will be a general discussion on "The Effect of Work on the Mechanical Properties of Non-Ferrous Metals," including the following Papers:—"Some Observations on the Forging of Strong Aluminium Alloys," by G. Sachs; "A Comparison of the Extrusion Properties of Some Aluminium Alloys," by C. E. Pearson; "The Effect of Drawing on the Hardness and Tensile Strength of Brass Rod," by M. Cook and G. K. Duddridge; "The Effect of Composition and Constitution on the Working and on Some Physical Properties of the Tin-Bronzes," by R. Chadwick. In the afternoon there will be a general discussion on "Industrial Application of Spectrography in the Non-Ferrous Metallurgical Industry," introduced by F. Twyman.

Publication Received

The Iron and Steel Trades in 1938.—A Special Review. Published by William Jacks & Company, Limited, Winchester House, Old Broad Street, London, E.C.2. Free on application to the publishers.

As one reads this publication year by year, it is impossible not to notice the ever-increasing effect of politics—mainly repercussions from abroad—on the heavy industries. The review of the iron and steel trades is masterly; the angle from which it is written, being that of the merchant, makes it more than usually interesting as it necessarily brings into focus the fields of both manufacturer and consumer. The point stressed in these columns as to the profound influence of major movements in price levels and the slowness of federations in making adjustments is well handled and shows up that the *via media* between individual freedom of action and pure dictation is still suffering from teething troubles. Knowledge that prices are to be readjusted on a certain date, but ignorance of the magnitude of the changes, acts adversely to the best interest of both parties. The booklet contains a reprint from the "North-Eastern Gazette" of an article on pig-iron, which is followed by notes on hematite; the steel trade; imports and exports; wages; and the scrap trade. Altogether this is a very useful publication.

Beans Industries, Limited.—Profit, £86,251; brought in, £13,257; tax and N.D.C., £27,000; ordinary dividend of 22 per cent., making 32 per cent.; to pensions account, £5,000; to general reserve, £20,000; carried forward, £20,320.

International Combustion, Limited.—Net profit for the year ended September 30 last, £231,933; brought in, £17,878; final dividend of 12½ per cent. and a bonus of 12½ per cent. on the ordinary shares, making 32½ per cent. for the year; to general reserve, £50,000; to taxation reserve, £55,000; carried forward, £21,510.

Random Shots

Last week's brain duster has been solved by an agile thinker from Scotland, who claims that the engineer must necessarily be Smith. His reasoning is as follows:—Since the guard lives halfway between London and Birmingham, his nearest neighbour can live in neither city, and thus cannot be Mr. Robinson. Furthermore, the guard's nearest neighbour, who earns £600 per annum, cannot be Mr. Jones, whose yearly earnings total £400. The name of the guard's nearest neighbour is therefore Mr. Smith. The gentleman resident in London is therefore Mr. Jones, and the guard's name is Jones. Thus, since Smith beat the fireman at shove halfpenny, the name of the fireman, neither Smith nor Jones, is Robinson, and that of the engineer, by elimination, is Smith. Waving this problem on one side as being childishly simple, he offers what he calls a Monkey Puzzle, which "Marksman" hopes to reproduce next week, thus providing, in the words of the correspondent, "a *real* opportunity for foundrymen for applying their undoubted powers of deductions."

* * *

The epidemic of Branch dinners during the past week or two has yielded an unusually good crop of after-dinner stories. At the Lancashire dinner Mr. Hepworth told of two moulder brothers who had been left a considerable fortune. What to do "wi' t' brass" seemed to be the great problem. One elected to go round the world, whilst the other's horizon got no farther than the beer mug. Coming back from his world tour, the one boasted that he'd seen everything, even to the seven wonders of the world. "Hast'a ever 'ad the D.T.s, me lad?" demanded the other. "No, I ain't," admitted the travelled one.

"Well, then, tha's seen nowt!" was the beer-drinker's retort.

* * *

At the Sheffield dinner the Lord Mayor told how, having asked a little girl her age, he received the reply: "I'm five, but I'd have been seven if my father had been able to get a house sooner."

* * *

Another of the Lord Mayor's stories was of a Jewish boy who took the baby out for an airing in the pram. On his return his mother screamed at him, "But this isn't our Rebecca. What have you done with her?"

"I don't know," said the lad. "She mayn't be as good looking as our Rebecca, but I've brought home a much nicer pram."

* * *

Nor was his wit confined to stories, for his speech was nicely peppered with epigrams. A great financier, he declared, is a man who has some money left after allowing his wife and family to spend what they like! He also said that education has made such progress that rude words are now written much lower on the blackboard.

* * *

At the same dinner, Professor Swift said that he resisted a temptation to gag, for, after all, gaggers are hung up and buried in sand!

* * *

Apropos of dinners, a little girl, staying up later than usual one evening, saw her father in his evening dress for the first time in her life. She eyed him up and down for a few moments and then said: "Daddy, is that your divorce suit?"

"MARKSMAN."

Precision-Production of Metal Patterns and Core Boxes

USE OF THE THREE-SPINDLE KELLER AUTOMATIC TOOLROOM MACHINE

The adoption of automatic methods in foundries and the tightening up of tolerances on castings so that they will fit the jigs used in the production methods in machine shops have necessitated the production of more accurate patterns. In a number of instances it is necessary to make the patterns of harder materials than the ordinary "pattern metal." This is particularly so where patterns get rough usage in the foundry and have projections on them which are easily damaged.

In addition to patterns, core boxes have to be made more accurately, and as the number of core boxes required is generally a multiple of the number of patterns, absolute duplication is most desirable. This increased accuracy is such that it is difficult to obtain by the ordinary casting and hand-polishing method of producing patterns and core boxes, and it has become necessary to machine them from an accurate master.

For castings with very thin wall-sections it is essential to have really accurate patterns. The savings in metal resulting from the use of accurate patterns for large castings is considerable, and more than offsets the cost of this type of pattern over a cast pattern. An interesting example of this is provided by a firm in America which makes domestic heating radiators. Their annual sales approximate 20,000,000 sq. ft. of radiation surface per annum. By producing accurate patterns and cores, 1 lb. of iron was saved per sq. ft. of radiation. A saving in freight was also obtained. This was as high as 12½ per cent. per sq. ft. of radiation. An example of machining radiator patterns is shown in Fig. 2.

Pratt & Whitney, makers of the well-known Keller automatic toolroom machines, have recently developed a three-spindle machine which is essentially suitable for metal-pattern work, and about twenty machines have already been installed in the leading metal-pattern shops of America. This machine is shown in Fig. 1. It can best be described as a machine having all the normal movements of a milling machine, but with the aid of the Keller electrical control it is capable of following from a template or model any irregular shape either two- or three-dimensionally. One of the features of the control is that the load on the tracer or copying spindle is approximately 4 to 6 ozs., irrespective of the size of cutter or depth of cut. Consequently models of soft materials, such as wood, etc., can be satisfactorily used as masters. In the illustration three contours are being machined simultaneously from a wooden model.

The machine is available in several sizes, capable of dealing with patterns up to 36 in. long at one setting, and can have either 8-in. or 10-in. centre spacings of spindles.

As it can be used as a one-, two- or three-spindle machine, three patterns 8 in. wide or two 16 in. wide can be machined at the same time. Where patterns exceed this width, they can be machined singly. On the 10-in. centre spacing machine three patterns 10 in. wide and two patterns 20 in. wide can be handled.

Prior to the introduction of the three-spindle machine, Pratt & Whitney have made a single-spindle machine of which large numbers are in use, and the second illustration shows a pattern being machined on a single-spindle machine. Such patterns can, of course, be produced equally well on the new machine, and where the dimensions fall within those given above, they can be produced in duplicate or triplicate.

The metal pattern for the radiator shown in Fig. 2 was machined from a universal model. This model was made adjustable in all dimensions; consequently patterns for a variety of sizes of radiators could be machined from the one model. The accuracy of patterns produced by this method enabled uniform metal thickness of the wall section to be maintained, and eliminated weak spots.

Where metal patterns can be produced by the ordinary method of casting the plate and hand-finishing, they are cheaper than those machined all over on the Keller machine. This is satisfactory where patterns do not call for any great degree of accuracy, and can therefore differ slightly from each other. This method, however, becomes more costly if a good deal of hand finishing has to be done so carefully and skilfully that the resultant patterns will be identical, and even then they are not as satisfactory as machined patterns.

The main advantages given by the use of these machines are that all patterns and coreboxes so produced will be identical, and in production moulding the core made in any corebox will fit in any pattern and no expensive labour is required to trim either mould or core. Also, there is no time delay in setting the cores, which work is done on production moulding by the cheapest type of labour.

As an instance of the economy which is possible by the use of the machine, the case of a master pattern for a core-drying shell may be mentioned. Machined from a master template, this pattern required a total machining time of four days, as against three weeks necessary before the machine was installed.

In brief, whenever more than one of a kind of pattern or corebox is required, or the moulding and casting are done on a production basis, it has been found that Keller-machined patterns are in the long run cheapest to produce and most satisfactory to use.

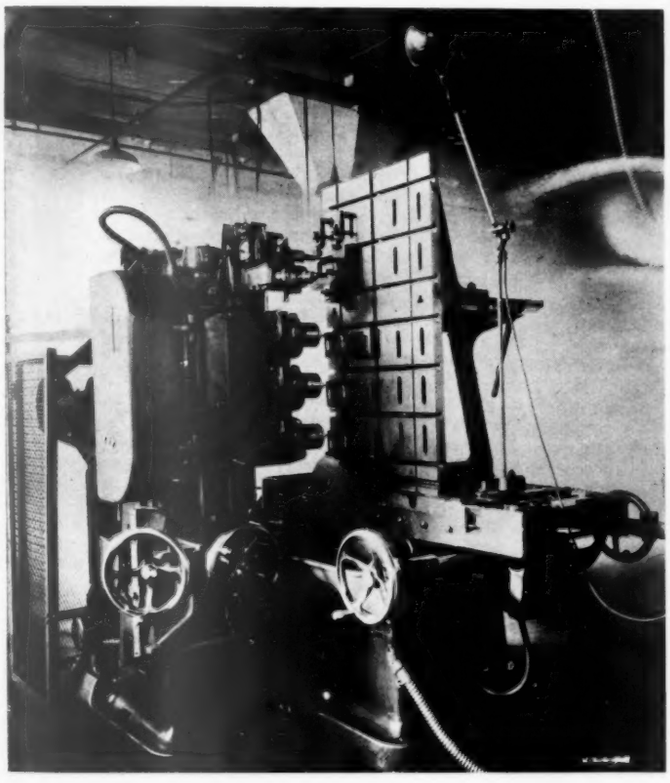

FIG. 1.—THREE-SPINDLE KELLER AUTOMATIC TOOLROOM MACHINE.

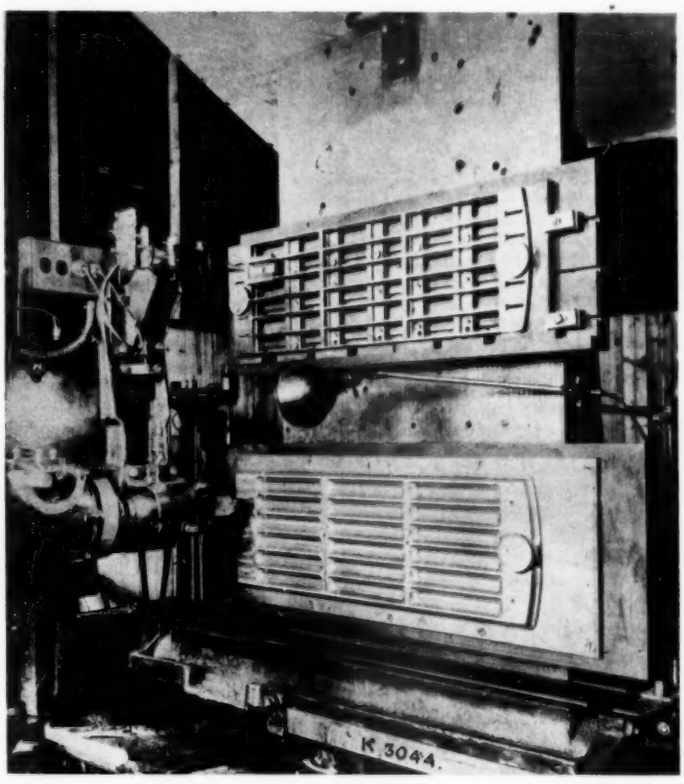

FIG. 2.—SINGLE-SPINDLE MACHINE PRODUCING RADIATOR PATTERN.

Lancashire Foundrymen's Annual Dinner

The annual dinner of the Lancashire Branch of the Institute of British Foundrymen was held at the Grand Hotel, Manchester, on February 4, with Mr. H. V. Grundy (Branch-President) presiding. Among those present were Mr. R. W. Stubbs (Past-President of the Institute and Chairman of the Manchester and District Ironfounders' Employers' Association); Prof. Dempster Smith, M.B.E., M.Sc. (President, Manchester Association of Engineers; Department of Mechanical Engineering, College of Technology, Manchester); Mr. J. Hepworth, J.P., M.P. (President, Institute of British Foundrymen); Mr. G. E. Windeler (Chairman, North-Western Branch of the Institution of Mechanical Engineers); Mr. F. D. Webb (Secretary, Manchester and District Ironfounders' Employers' Association), and Mr. T. Makemson (Secretary of the Institute), most of whom were accompanied by their ladies.

The loyal toast having been honoured, the toast of the Institute of British Foundrymen, coupled with the Lancashire Branch, was proposed by MR. G. E. WINDELER (Chairman of the North-Western Branch of the Institution of Mechanical Engineers). Declaring that the toast must be the most important in the engineering industry, he said that the Secretary, Mr. T. Makemson, had supplied him with a quantity of data from which it was possible to discover the achievements of the Institute. There were 2,500 members, with Branches and Sub-Branches all over the country. There was also a very lusty youngster in the form of overseas membership. Any Institute which could carry an overseas membership must be a vigorous organisation; to keep those members interested in the work of the Institute was a really creditable piece of work. He had found also that there was an international organisation of foundry institutes whose members had been invited to hold their annual congress this year in London.

What did the Institute of British Foundrymen stand for? He learned that its objects were (*a*) to promote the technical development of the foundry industry, and (*b*) to promote and develop the technical and craft knowledge of the personnel engaged in the industry. If the Institute could maintain those objects, and it was doing so, then the success of the organisation was assured.

A Compliment to British Foundries

He found that a great number of most intriguing Papers, ranging from such subjects as "Moulding Sand" to "Mechanisation of Foundries," had been read during the past session. In addition, there had been visits to works and exhibitions, with an occasional social event. He was amazed at the scope of the Papers. After reading them he came to the conclusion that foundrymen were scientific in their methods of working to a degree of which the outside world never gave a thought. Some people, although they bought castings and inspected them, really knew nothing about them. Some of the most beautiful work he had ever seen was being produced at British foundries. The castings were not just a job of work, but were objects of art, because they had to be made from the inverse order in which a designer arranged matters, and, as they all knew, designers could make mistakes.

Progress in the Industry

MR. J. HEPWORTH, J.P., M.P. (President of the Institute), said he felt it to be a great honour as well as a privilege to be permitted to respond to the toast. They would all be acquainted with the memorandum sent out by the Council to the effect that it was intended to increase the subscription. The intention had not been embarked upon with any ulterior motive, but in order to provide the members of the Institute with better facilities and to emphasise their status. He, for one, would like to know that, when a member wrote the letters M.I.B.F. after his name, they carried equal weight with such designations as M.I.C.E. or M.I.Mech.E. This desirable objective could only be achieved by developing the technical side of the industry, and that was what the Council was endeavouring to do. The foundry was the basis of the engineering industry, and if it had not been for the success it had achieved in producing castings, where would the engineering industry have been now? They wanted to maintain their engineering trade both at home and abroad, and to attract the finest type of young men into the industry by giving them suitable encouragement. In former days parents strove to give their sons a classical education, entirely neglecting the technical side of their schooling. Those of them who were interested in education would be aware that, recently, the Spens Report had been issued, and the terms of it were to afford a more technical education to young people in secondary schools, fitting them more adequately for the particular industry they intended to embark upon for their life's career. Conditions in the foundry were not at present ideal, but there were signs of great improvements being effected in regard to research work generally. He hoped that the progress of that improvement would be well maintained in future.

The Visitors and Ladies

The toast of "Our Guests" was proposed by the Branch-President, MR. H. V. GRUNDY. He thanked Mr. Windeler and Mr. Hepworth for the very kind remarks they had made about the foundry world and about the Lancashire Branch in particular. In referring to a number of visitors by name, Mr. Grundy mentioned that Prof. Dempster Smith had been responsible for the equipping of a large number of engineers with the practical knowledge which was to stand them in such good stead in their professional careers. He had learned that the Professor was finishing his scholastic duties on the following Monday, which coincided with his birthday. On behalf of all present, he ventured to wish him many happy returns of the day and continued good health in his well-earned retirement.

The Lancashire Branch could probably take the honour to itself of having originated the idea of inviting ladies to their annual dinner from the time when Mr. R. A. Miles occupied the chair about 1924. Although the ladies were mentioned in the official list as visitors, he failed to see that the term was quite correct. In Lancashire they looked upon the ladies as being more in the light of "reserve" members, and the Branch felt that it was strengthened by its reserve of ladies who were interested in its work. They were found quite a lot of work to do, which they invariably carried out with great eagerness. In the present year their assistance would be most helpful in regard to the holding of the International Conference in London. Subsequent to that Conference, Lancashire would be entertaining quite a number of delegates, who intended to spend a few days in the county area. With the assistance of the ladies, it was hoped to make their visit as pleasant and as entertaining as possible.

MR. ROY STUBBS, in responding to the toast, thanked the members for the honour they had done him in asking him to respond to the toast of the guests, which he did with pleasure and enthusiasm. The honour was the greater and the responsibility the heavier as he had to try to respond adequately for all the visitors, and they were a very distinguished company.

In the first place, there was the President of the Institute, Mr. Hepworth, whose versatility was incomparable, who legislated in the Mother of Parliaments, who dispensed justice with peace, and sat in Olympian state guiding the destinies of 13 immortals on Saturday afternoons with suitable words of encouragement or otherwise, and from whose seraphic countenance emanated those words of wisdom which added dignity and lustre to the deliberations of the Institute when he presided over its meetings.

Mr. Windeler was, as they all knew, a very distinguished member of the Manchester Association of Engineers, and through his diligence he had been awarded both the Constantine and the Butterworth gold medals. Mr. Windeler was such an expert on gold that he had made several visits in a professional capacity to South Africa.

Finally, Mr. F. D. Webb was known to them as a very distinguished chartered accountant.

Presentations

The President of the Institute then presented the R. A. Jones Gold Medal to Mr. J. Laing, of Oldham, for a Paper entitled "Gating and Pouring Temperatures in the Non-Ferrous Foundry," and also the Silver Medal to Mr. R. S. Turner (of Manchester) for his Paper "Runners and Risers."

Both recipients responded.

The presentation of the Diploma of the Institute was to have taken place in the case of Mr. A. Phillips (Manchester) and Mr. W. J. Rees (Sheffield), but both gentlemen were unavoidably absent.

The dinner was preceded by a whist drive, and a considerable number of prizes was distributed. There was dancing until 11.45 p.m.

Shipbuilding Prospects

A gloomy picture of shipbuilding prospects for the present year was painted by Mr. A. Murray Stephen, President of the Shipbuilding Employers' Federation. British merchant shipbuilding faced 1939 with anxious misgivings, he said. A 12 months' launching output of 1,000,000 tons gross of merchant shipping was matched by new mercantile orders of less than one-third of that total. With work already on the berths, the 300,000 tons gross of orders gave a prospect of only one-quarter of Britain's 2,000,000 gross tons annual shipbuilding capacity being occupied with work at no distant date. The existing state of affairs was not only depressing but, from the national point of view, frankly alarming.

Faced with the formidable array of subsidies granted to shipbuilders in other countries, and competitive conditions which depended for their effectiveness on wages and general living standards far below our own, a most welcome stimulus came from the steel prices reduction which were operative from January, 1939. The decision to widen the scope of the export credit facilities granted by the Government was also welcomed.

Book Review

Handformerei: Werkstattbucher. Vol. 70. (Hand Moulding: Workshop Manuals, Vol. 70). By Fr. Naumann. Edited by H. Haake. Published by Julius Springer, 22-23, Linkstrasse, Berlin. Price 2 R.M.

This small handbook, comprising 52 pages and 202 descriptive illustrations, is divided into four sections, namely, patternmaking, strickle moulding, plaster-pattern making, and making castings direct from drawings. Each section describes in considerable detail typical examples of classes of the above work as applied to jobbing moulding, and shows to advantage the potentialities of the skilled moulder which are apt to be overlooked in this mechanical age.

Whilst some of the examples cited might not be new to some of the older foundrymen, this booklet is well worth perusal by the younger men, as it supplies a welcome change from the present trend towards excessive core utilisation. Indeed, if translated it would make an excellent textbook for the practical side of foundry technology courses.

J. B.

Iron Castings *versus* Steel Fabrications

MOCK TRIAL IN LONDON

A mock trial, which was both amusing and instructive, was arranged at a joint meeting of the London Branch of the Institute of British Foundrymen and the Institute of Welding last Wednesday, in the lecture hall of the Institution of Mechanical Engineers, London, S.W.1.

The President of the Court (Mr. W. Tudor Davies, B.A., Barrister-at-Law, F.R.Econ.S.) and a jury heard an action by "Lord Ian Casting of Ferrous Court" (Plaintiff) for an injunction against "Steel Fabrication, Esq., of New Terrain" (Defendant). Counsel for the Plaintiff was Mr. R. B. Templeton. Counsel for the Defendant was Mr. A. Kershaw. The jury comprised Mr. H. W. Cadman, Mr. W. B. Shannon, Mr. J. L. Dixon, Mr. C. G. Green, Mr. J. B. Palmer and Mr. R. Wailes. Witnesses were:—For the Plaintiff, Mr. P. A. Russell, Mr. C. H. Kain and Mr. J. N. Burns. For the Defendant, Mr. T. A. Swindell, Mr. L. A. Ferney and Mr. E. B. Shore. The Clerk of the Court was Mr. C. G. Bainbridge.

Nature of the Action

The Plaintiff sought an injunction restraining the Defendant from manufacturing, selling or causing to be sold certain types of structures which had hitherto been manufactured exclusively by the Plaintiff. The Plaintiff claimed that such structures were copies of his work, were uneconomic and had defects which were not present in his manufactures. The Plaintiff further claimed that his structures had qualities and usages which were not possible in the Defendant's structures, and that competition of that type was harmful to his business and likely to cause hardship to his employees.

The Defendant opposed the injunction on the ground that his structures were not copies of the Plaintiff's structures, that they had definite qualities of light weight and strength and could be produced at less cost than those manufactured by the Plaintiff. The Defendant counter-claimed for the allotment of an agreed field of activity for his manufactures and offered to train certain employees of the Plaintiff in his type of manufacture, which would thus prevent hardship to the Plaintiff's employees.

OPENING ADDRESS ON PLAINTIFF'S BEHALF

MR. R. B. TEMPLETON, opening the case for the Plaintiff, first apologised to the Court for the absence of his client, who was seriously indisposed by an illness due to worry over the action. Counsel said he was informed that the several cylinders of oxygen kindly supplied by his learned friend for the defence had been administered that afternoon without success, and as a last resource his client's medical advisers had decided that the only thing which could help him was a course of treatment in the cast-iron lung!

His client, he continued, appealed for the protection of the Court against the activities of the Defendant, which were causing grievous harm to his client's business of manufacturing and selling articles, goods, and so on, made in cast iron. His client, as an ironfounder, was engaged in an industry which had been in existence for many centuries, and was one on which almost every branch of engineering relied for the major components of machines, tools, engines and structures; and it was generally admitted that cast iron was the raw material for all engineering.

Founding, as a craft, was older than engineering itself, and the origin of ironmaking was lost in the mists of forgotten ages. In the time of Homer the manufacture of iron was well known, and the Egyptians had made and used it in an early period of their history. As further evidence of the antiquity of ironmaking, Mr. Templeton quoted from the Book of "Genesis," Chapter V, verse 23:—

> "And Zillah she also bare Tubal Cain an instructor of every artificer in brass and iron."

When that was brought to his knowledge by a friend, he said, he had been so amazed and impressed by it that he had read three or four more chapters of "Genesis" in order to see whether it had anything to say about welding. He regretted to say that he had found no reference to it whatsoever—though he felt sure that, if Zillah's other offspring had been a welder, the writer of the Book would have been impartial enough to have mentioned it! The extraordinary thing was, he continued, that Tubal Cain was not a moulder or cupola attendant, but was an *instructor* of every artificer in brass and iron. That would indicate that the foundry industry was well organised in those ancient days; and perhaps the Institute of Welding and the Institute of British Foundrymen, with their schools and courses of instruction, were not so modern and up-to-date as they would have us believe.

A Bungaloid Growth!

Welding might almost be looked upon as an upstart or bungaloid growth when compared with the time-honoured tradition of the iron-founding industry. Moreover, he emphasised that scientific thought and research had until very recently been concentrated on the newer industry and, therefore, had missed the fact that founding was now capable of a control which was comparable with the precision of a tool room.

It would seem that the people engaged in the foundry trade were peculiarly modest, and sought to avoid all forms of publicity. The foundry trade had been called the Cinderella of industry. Cinderella was a charming girl, but, to use a film expression, her self-effacing personality "did not go over big" in these days of sex appeal. It was up to the foundry industry to pluck its eyebrows, to put on some make-up, and generally to copy the bold contours of Mae West rather than the demure draperies affected by Cinderella!

His client, he continued, had no wish to restrain the activities of any industry where such activities were confined to their legitimate sphere, and were economic to the user in that particular sphere; but the Defendant had wrongfully entered the sphere of the iron-founding industry by introducing welding, a process which was not economic to the user. The Plaintiff was prepared to admit that the use of welding might be of some value in repairing occasional surface defects in his castings; but there, again, such repairs should be done only with the permission of the inspection department of the user.

It was of interest to note that all Government Departments, railways and most large commercial users of castings had a clause in their specifications stating that the welding of casting defects should not be carried out. Was that precaution, he asked, due to distrust of the relative physical properties of the weld and the casting? There could be no doubt that if inspection authorities were satisfied that the process of welding a faulty casting did not set up stresses in the casting, and that the physical properties of the weld were equal to those of the casting, and the structure of the weld was as homogeneous as that of the casting, then there would be no reason to retain that clause in their specifications; and he would be able to prove by evidence that that distrust had a very real foundation in fact.

Overselling

The rather questionable methods adopted by some of the welding industry in their sales efforts in some cases bordered on the fantastic. Cast iron was openly condemned, and in making comparisons with welding, the low-grade coarse graphite irons of 20 years ago were referred to. Mention of the present-day high-duty and alloy cast irons was carefully avoided. In his submission, that was unethical and simply amounted to overselling an article—a method which was bound to react very unfavourably on its authors sooner or later. One well-known American firm had gone so far as to print in their advertisements the following:—

> "If it is made of steel, weld it.
> If it is made of cast iron, change it."

He would leave it to the Court to decide whether or not such methods were desirable. But he quoted the following extract from the editorial of "The Welding Engineer," dated May, 1931:—

> "Although it is difficult to restrain the zeal and enthusiasm of those who see an industrial revolution in every new discovery, without appearing to be a wet blanket it is just as well to face the facts in promotion work and refrain from making statements which are so far-fetched as to create a strong feeling of doubt on the part of those who are well informed."

Therefore, he wished to make it clear that his case was to restrain the Defendant in advocating the use of a welded steel fabrication to replace a component, machine, jig or tool, and so on, which had previously been made as a casting.

Properties Compared

It would be agreed that engineers designed on the elastic properties and yield points of a material, and he gave the following comparison of a high-duty cast iron and weld metal:—

	True elastic limit.	Yield point.	Tensile.
Weld metal ..	7 tons	17.5 tons	27 tons
High-duty cast iron ..	7–9 ,,	20 ,,	20–25 ,,

Thus, he said, the elastic properties of the high-duty cast iron were as good as, if not better than, those of a welded steel.

No doubt the Defendant would claim that weld metal was a homogeneous mass, which in some cases was stronger than the parent metal. That was far from being the case, however, and a mass built up of alternate zones or layers of metal differing widely in structure, ductility and composition could only be called a very heterogeneous mass. The enlightened foundryman controlled the composition, structure and the cooling rate of his castings, thereby ensuring a homogeneous mass; but a weld was a series of microscopic castings of uncontrolled composition and uncertain thermal history.

The Nature of Welds

In the manufacture of rolled steel girders, joists and angles, which were jigsaw pieces used by his welding friend in his structures, the steel had been treated by the steelmakers in order to develop its maximum properties of strength and ductility. Its heating had been conducted with care and its mechanical treatment, rolling and forging had been controlled to give correct grain size. In welding, those pieces of steel were joined together by the depositing of metal not subject to any treatment. In making the welds the parent metal was heated to its fusion point, and the steelmaker's work was ruined and its effect lost. Even if the physical properties of the weld were as good as those of the original metal, the parent metal immediately adjacent to the weld had been subject to overheating and was adversely affected.

It would be claimed that the process of welding did not set up stresses which distorted the welded structure. But if one heated a cube of

steel or cast iron it would expand uniformly in all directions and would also contract uniformly, unless restrained from doing so by mechanical forces. Therefore, one was faced with that problem of expansion and contraction in welding any steel structure. That condition was aggravated as the section and stiffness of the structure increased.

There could be no doubt that some stress or strain remained in the welded structure, and that could be relieved only by annealing, which would probably affect the strength and adhesion of the weld and also the strength of the rolled steel section. In any case, to anneal a fabricated bed plate, machine, jig or tool fixture would entail the use in most cases of a very extensive furnace.

He invited the Court to consider the effect of that condition of stress or strain on a precision type of machine or tool, and pointed out that there would be a dimensional change from time to time.

The property of rigidity and stability which could be obtained in cast iron was well known, and its characteristic feature of "staying put" could not be too strongly emphasised in applications of that sort. In a welded structure the parent metal expanded locally under the heat of the welding, and subsequently contracted as the joint cooled down. That movement, if restricted, set up internal stresses, or must produce distortion in parts which were free to move.

Consideration of design was important in any casting, but it was of vital importance in a welded structure if residual stress and subsequent trouble was to be avoided. The perfect design of a fabricated machine tool, structure, and so on, might easily be spoiled entirely by such factors as inaccuracy of fit-up, incorrect sequence of welding and faulty technique.

Inspection and Testing

The success of welding, whether on a casting or an assembly of rolled steel, depended practically entirely on the skill and technique of the operator, and it was impossible to test the soundness of a weld except by X-ray examination. A casting having to comply with a definite specification could have a bar cast on which would prove the physical and other properties of the material. A bad casting or inferior material could be detected or scrapped by that test-bar; but a bad piece of welding went into service alloyed with 5 per cent. of faith, 10 per cent. of hope and 15 per cent. of charity!

A pessimist might say that these were days of declining craftsmanship, and if that be so it would become more and more difficult to obtain reliable operators, whether they be moulders or welders. The value and importance of inspection, therefore, would become more vital as time progressed.

It would be agreed that cast iron and even the high-duty cast irons had a low Izod impact test value; and whilst such a test was not considered a fair criterion of a so-called brittle material as cast iron, he submitted that there were so little data available on the Izod value of weld metal or a welded structure that it would be unsafe to assume that it was much higher than that of a high-duty or alloy cast iron.

Legal Action in U.S.A.

There was a recent law suit in America owing to a welding failure on a large hydro-electric construction. The welding company had guaranteed that the weld would be solid and equal in all its physical properties to the steel plate used. Unfortunately, most of the penstocks had cracked. Of those which did not fail, sections were taken, and it was found that 37½ per cent. of the welds were sound, 50 per cent. had shown inclusions of slag and gas holes over varying areas of the welds, and 12½ per cent. were merely mechanical conglomerations.

The PRESIDENT OF THE COURT asked how those conclusions were arrived at.

MR. TEMPLETON replied that they were arrived at by repeated impact tests. Coupons were trepanned out of the pipes at the weld and also the plates, and submitted to repeated impact test, with the following results:—

	Steel plate.	Blows.	Plate at weld.	Blows.
No. 1 ..	Fractured after	25	Fractured after	3½
No. 2 ..	,,	28	,,	3½
No. 3 ..	,,	31	,,	2½
No. 4 ..	,,	30	,,	2½

Those tests showed that the impact value of the weld metal was less than 14 per cent. of that of the plate itself. Assuming the steel plate, therefore, to have an Izod value of 50 ft.-lbs., the Izod value of the weld metal would be less than 7 ft.-lbs.

Compression Strength

Referring to the property of compression strength, he said that a low-grade cast iron of 10 tons tensile strength had a compressive strength of 40 tons per sq. in. A high-duty cast iron of 20 to 25 tons tensile had a compression strength of 75 to 80 tons per sq. in. Mild steel of 30 tons tensile had a compressive strength of 40 tons.

Those figures were important, and if one were to make a survey of the stresses to which any series of machines, structures or tools were subjected in service, it would be found that compression stresses predominated largely, and tensional, transverse or torsional stresses were encountered to a much less degree. The welding salesman would say that deflection was the major factor in design. That was not correct, however, as most engineering structures were designed on a strength basis and little consideration was given to deflection.

Damping Capacity and Fatigue

The rigidity and high damping capacity of cast iron were two properties of first importance in any structure or machine which was subject to alternating or pulsating stresses, and owing to their inability to obtain those characteristics in a fabricated structure, many manufacturers of presses, shearing machines, motor casings, and so on, had reverted to the use of castings.

Coming to the subject of fatigue, which was so vast that he could not deal with it at all adequately in the time at his disposal, Mr. Templeton pointed to the statement in the Report of the Welding Panel of the Steel Structures Research Committee, page 195 (published 1938), that "The fatigue strength of weld metal is definitely lower than that of mild steel of the same strength; this is primarily due to the presence of blowholes, inclusions, etc., which act as stress raisers." The figures in that Report, he said, showed the fatigue strength of weld metal to be about 50 per cent of that of the parent steel.

Elements of Costs

Dealing with costs, he said the favourite argument of welding exponents was that a welded structure cost less than a casting and was lighter, and that there was no need to make a pattern. On the other hand, the manufacture of welded steel constructions involved large shop space, cranes, wastage of material in fabrication and high investment in punches, shears, rolls, welding and riveting equipment—the overhead of the capital invested had to be absorbed just as had the flasks and moulding machines in the foundry, and they were no mean items.

The problem of relative costs between a casting and a fabricated structure was a difficult one. Where a "one-off" job, which would not repeat, was required, an economy might be shown by using a welded structure; but if more than one off were required, he maintained that a casting was cheaper. Fabricated structures cost between £30 and £50, whereas castings could be obtained at from £20 to £35 per ton, the casting figures including the cost of pattern. Anyone who might be in doubt on that point should probe the comparative costs before substituting cast steel or cast iron by a welded structure.

To confirm that point, Mr. Templeton put in as evidence a letter from an ironworks in this country, giving an actual example, as follows:—

	£	s.	d.
Ordinary cast-iron crane gearbox pattern ..	6	0	0
Moulding	3	15	0
120 per cent. overheads	4	10	0
Metal, etc.	4	18	0
	19	3	0
If that were fabricated it would only weigh 10 cwts., at £12 per ton = £6	6	0	0
Wages and overheads at £60 per ton ..	30	0	0
	36	0	0

The letter pointed out that on that class of work the fabricated job was considerably more expensive, although lighter. The machining of the fabricated job, it was stated, would also be a little more expensive than the cast iron. The writer of the letter had added that, generally speaking, there was a good deal to say for fabricated work, but it could not be applied to everything. He often thought that people had gone rather mad about it, and merely fabricated things for the sake of saying they were fabricated, irrespective of what the job was costing.

Dealing with the question as to what was an arc weld, Mr. Templeton said that the American Bureau of Standards, in connection with their investigation into arc welding, had stated:—

(1) A fusion weld is fundamentally different in that the metal of the weld is essentially a casting.

(2) The mechanical properties of arc fused metal as measured by the tension test are essentially those of an inferior casting. The most striking feature is the *low ductility of the metal.*

(3) All specimens of welding examined showed evidence of unsoundness in their structure. Tiny enclosed cavities, oxide inclusions, and lack of intimate union. These features of unsoundness are a seemingly necessary consequence of the method of fusion as now practised.

The PRESIDENT asked why reference was made to the American Bureau of Standards, and not the British Standards Institution.

MR. TEMPLETON replied that, unfortunately, he had not the B.S.I. information. He had obtained this information against welding from the American side.

Corrosion

Finally, he dealt briefly with corrosion. He pointed out that, on exposure to atmospheric corrosion, ordinary grey cast iron was superior to steel or wrought iron. High-duty cast irons were from two to three times more resistant to atmospheric corrosion than was ordinary grey cast iron. Impure or unsound steels corroded more rapidly than sound steels. As a weld at its best was no better than an unsound casting, it was safe to assume that its corrosion-resisting properties were very poor, and the insidious corrosive attack in service was a feature of real and grave danger.

EVIDENCE FOR THE PLAINTIFF

MR. P. A. RUSSELL, B.Sc. (Director of S. Russell & Sons, Limited, ironfounders and engineers), gave evidence on behalf of the Plaintiff. His firm, he said, made a high-duty cast iron, which complied with Grade 3 of B.S.S. 786. On the engineering side of the business the

firm made use of welded structures. Thus he could speak, he hoped with authority, on the use of both welded structures and castings.

Superiority of Cast Iron

Asked in what respect a casting was superior to a welded component, he referred in the first place to its rigidity, which was of vital importance in most machinery components, particularly main frames and beds. Secondly, its damping capacity for vibration, which reduced the communication of machine vibrations to the floor and also reduced noise. Thirdly, its resistance to atmospheric corrosion, which was too well known to need elaboration. Fourthly, its appearance, because round corners and curves could easily be introduced into a casting, whereas the usual characteristic of a fabricated component was its large number of sharp and even dangerous corners. Fifthly, there was less risk of failure on a casting through unobserved defect than on a welding, for the quality of metal in a casting could be proved by tests and analysis, whereas the quality of metal in a weld was entirely dependent upon the skill of the operator, and bad welds were very difficult to detect. Sixthly, its cost; in nearly all cases where more than one of any particular design was required, the cost of a casting was less than that of a welded component.

MR. TEMPLETON said it had been stated that welding was more popular than castings with engineers, and he asked to what Mr. Russell would attribute that supposed popularity.

MR. RUSSELL replied that he believed the statement had been made. He attributed it to the failure of the designer to appreciate the improvements that had been made in cast iron during the last twenty years. It was safe to say that the average tensile strength of engineering castings had improved 50 per cent.—from 10 to 15 tons per sq. in. There were on the market several types of cast iron showing over 100 per cent. improvement, with tensile strength of 20 to 25 tons per sq. in. Those types of iron were well proved and were being used by public bodies, such as the Admiralty. In addition, the soundness and uniformity of cast iron had greatly improved.

Asked in what way the introduction of welded components damaged the cast-iron industry, he said by taking a large proportion of the "one-off" trade, particularly for bedplates and jigs, thus causing unemployment and loss of business. Certain foundries which had relied on that trade had disappeared entirely. That had had a great reaction on the recruitment of labour for foundries, as the type of foundry producing one-off jobs was an excellent school for the young moulder to gain experience. The result was that there was a serious lack of really skilled moulders to produce the intricate jobs that the welding firms could not tackle.

MR. TEMPLETON asked whether, in witness's view, engineers had taken advantage of the increased strength of the modern cast irons to lighten the sections and reduce the weight of their castings.

MR. RUSSELL said they had done so only to a limited extent.

MR. TEMPLETON, comparing a high-duty cast iron of 20 to 22 tons tensile with a cast iron of 10 to 12 tons tensile, and basing on the same factor of safety, asked to what extent engineers could lighten their castings by the use of the high-duty cast irons.

MR. RUSSELL replied that they could lighten them by at least 15 per cent., and in some cases considerably more.

Cross-Examination of Mr. Russell

MR. A. KERSHAW, cross-examining, asked if it were true that the improvements in the tensile strength and other qualities in cast iron were due almost entirely to the alterations in composition or alloying of cast iron.

MR. RUSSELL agreed that improvements were due to that cause, as well as to more careful control. He would not agree that the nearer cast iron came to an alloy steel in composition or characteristics, the nearer it came to perfection. He agreed that alloying and composition of cast iron was a very complex problem; but he pointed out that the improvement was due more to control of graphite, and not to the alloying to anything like the same extent. He agreed that the alloying and composition should be under the control of a trained metallurgist.

When he was asked what percentage of foundries in this country employed such metallurgists, Mr. Russell suggested that perhaps that was not a fair question; and Mr. Templeton objected to the question. The President suggested that Counsel for the Defendant should put it in another form.

MR. KERSHAW asked if it were admitted that the composition of cast iron in 80 per cent. of the foundries of this country was still measured largely in terms of barrowfuls of scrap, pig and coke.

MR. RUSSELL said it was not admitted.

Asked if he would like to suggest the percentage of foundries which had not careful control, he said that if one referred to foundries numerically, possibly the figure was fairly high; but taking the foundries producing the biggest number and weight of castings, he would say that 40, 50, or even 60 per cent. employed metallurgists to ensure control.

MR. KERSHAW referred to the use of a test-piece cast on the body of a casting at a specified place, and subsequently turned up and pulled according to the standard specification, and he asked if a specified diameter of test-piece could indicate the true tensile strength of any given section of the casting.

MR. RUSSELL replied that it did, provided the test-piece was produced and tested in accordance with the B.S.S.

MR. KERSHAW put the case of a casting having a number of heavy bars or ribs about 1 in. thick, intersecting, and the making of two test-pieces from the intersection point of two ribs (the test-pieces taken at right-angles to each other and crossing the intersection). He asked whether witness would expect those two test-pieces to show the same tensile strength as the ordinary cast-on test-piece, or whether he would expect them to be porous at the junction of the two ribs.

MR. RUSSELL said he would not expect that porosity if the casting were made in the proper kind of cast iron.

Minimised Mechanical-Strength Variations

MR. C. H. KAIN (foundry manager of Lake & Elliott, engineers and ironfounders) was the next witness for the Plaintiff. He said that his firm made special cast iron and cast steel; the special cast iron would comply with the various gradings of B.S.S. 786. The majority of his cast iron was cupola-melted, but he also made special cast irons by other processes.

Asked if he would have any difficulty in casting from the same cupola a large bedplate of heavy section on the same day as he wished to cast a small thin-section casting, he said he would have no difficulty at all, for that was part of the normal works control, and by adjustment of composition to suit the section he could obtain the best physical properties. Also, in the high-duty and high-strength cast iron the variation of strength in the varying sections of the castings was reduced to the practical minimum. He agreed that by "best physical properties" he meant strength, resistance to shock, resistance to wear, etc.

When asked whether cast iron would give better results than steel in a machine or tool slide, where resistance to wear was essential, he said that undoubtedly it would. A special cast iron would have three to four times the wear resistance of mild steel, unless the mild steel had been subjected to some expensive and special surface treatment.

Questioned with regard to the statement that cast iron had a higher damping capacity than wrought iron or steel, he agreed, and said that therefore it absorbed vibrations to a greater degree. That was a vital factor, for instance, in the frame or bedplate of an engine as a means of dissipating vibrational energy. That high damping capacity of cast iron would also reduce noise to a very great extent.

He agreed that cast iron was less sensitive than steel to the notch effect of sharp corners, interruptions, such as oil channels, etc.

Asked if that notch sensitivity would affect the fatigue strength of a component made in cast iron, compared with the same component made in steel, he said that, if of similar design and subject to the same stresses, its effect would be much lower on the cast-iron component.

Cross-Examination of Mr. Kain

MR. KERSHAW, cross-examining with regard to the point made by witness, that for tool slides, in which resistance to wear was essential, cast iron would give better results than steel, put the case of a casting designed to take so many tons sliding pressure, and asked what was the superiority of cast iron over steel, if the area of steel were increased so that the pressure per sq. in. was reduced by half. In other words, he asked if witness would agree that it was a matter of design rather than the type or construction of metal.

MR. KAIN said his statement was that cast iron would give better wear results than steel if subjected to the same stresses.

MR. KERSHAW: But there is nothing to prevent a designer designing for the same stresses with other material?

MR. KAIN: No.

With regard to the evidence concerning the damping capacity of cast iron, Mr. Kain said, in reply to a question, that he had seen some published figures of tests of cast-iron beams and welded beams. He was asked if he was aware that a certain vibration had distorted only 30 per cent. of the length of a welded beam, whereas it had distorted 10 per cent. more of the length of a cast-iron beam. He replied that he was not aware of that.

MR. KERSHAW, following a request from the jury for a definition of "damping capacity," said there was no more evidence for the damping capacity of cast iron than for the damping capacity of steel. He suggested that the only short description one could give of that term was that it was the capacity of a certain design of any structure having three dimensions (not merely a flat sheet of cast iron or other material) to absorb vibrations of a certain frequency. Every structure, he said, had a frequency of its own, and if the frequency of the work were outside the natural frequency of the structure, it did not matter. The problem had nothing to do with the actual material.

MR. TEMPLETON jocularly suggested that his learned friend was trying to deceive the Court.

MR. POLLARD (of the National Physical Laboratory) was then asked for a definition of damping capacity. He said he would have preferred notice of the question; but on the spur of the moment he could only define it as "the property of a material to absorb vibrations."

Curves and Cracks

MR. KERSHAW, resuming his cross-examination of Mr. Kain, suggested that if castings were made without curves, and with sharp corners in the internal coring, they would be almost certain to crack on cooling.

MR. KAIN replied that they were not "almost certain" to crack; but he agreed that the founder rightly aimed to avoid internal sharp corners.

Replying to a suggestion that the curves were developed in the first place as a necessity to increase strength, and only latterly for appearance, he said he did not think that was true, because many of our oldest castings were curved; casting in its early days was developed

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largely for artistic ends, and the curve was essential to an artistic casting. It did not follow necessarily that every curve and any work done in improving the shape and appearance of a casting increased the moulding costs.

Tooling and Distortion

MR. KERSHAW pointed out that a certain amount of hand tooling was necessary on every mould surface, and he suggested that the more curves there were, the greater was the amount of hand tooling and the greater the probability of distorting the shape.

MR. KAIN replied that that was so in the case of a one-off casting; but it was not true where there was any quantity of a casting produced, because tooling was then reduced to the minimum.

MR. KERSHAW asked if he agreed that the radius on the corners of the castings, and on the corners of the cores, was very largely in the hands of the core maker, and particularly the moulder, who rubbed off the corners of the cores, etc., and therefore often increased the thickness of the metal beyond the original design.

MR. KAIN said that that was so to a certain extent in a foundry which was run under very bad conditions.

Human Errors

MR. KERSHAW said he would like proof that the moulder was much more skilled and experienced and had much more control over his work than had a welder. He asked if the moulder was not just as liable to make an error or cause difficulties in coring and thickness and so on, or if it were not just as difficult to control the operations of a moulder as it was to control the operations of a welder.

MR. KAIN agreed that it was equally difficult to control. But it must be borne in mind that those matters affected the external appearance and dimensions of the castings, and therefore, they could be measured and inspected, whereas bad workmanship in a weld was not subjected to such inspection.

Motor-Vehicle Manufacture and Welding

MR. J. N. BURNS, plant engineer to a very large motor-car manufacturing concern, was the final witness for the Plaintiff. He said his position was such that he could evaluate the respective worth of castings and weldings. His firm operated a castings reclamation department which was scientifically organised so that the appropriate welding process was applied to each category of casting. The castings were annealed after welding; the larger ones were preheated in a continuous furnace, whilst both large and small were cooled slowly after welding.

Asked by Mr. Templeton whether the reclamation department was expanding, he said it was not; indeed, it was practically defunct, as careful investigation and close supervision had eliminated defects to which castings were liable. He made it clear that salvage welding was applied only to castings and such portions of castings as were subject to no working stress, *e.g.*, timing covers, external walls of water jackets, etc.

No Bias against Processes

MR. TEMPLETON asked whether witness could confirm that a prominent American engineer had stated that the motor-vehicle industry was "sold" to the extensive use of welding.

MR. BURNS said that that depended upon what was meant by "welding." In regard to spot, flash-butt and seam welding, which was automatic, he could say without equivocation that welding was an essential process for the production of modern motor-cars. But in regard to manually deposited welds the field was restricted to the reclamation of castings and a very limited amount of constructional work.

Asked whether there was any tendency to eliminate castings in his field, he said that the accumulated experience in manufacturing and servicing components was tending to focus design and research on the development of castings to replace welding wherever possible.

MR. TEMPLETON said he supposed witness would agree that motor-vehicle manufacturers had the reputation of being able to skin a flea! Therefore, presumably it was not because they liked the look of the foundryman or the colour of his eyes that they were giving him increased business.

MR. BURNS protested. The purchasing agents and production engineers associated with his industry, he said, were no less human than those in other walks of life. Because of the large quantities bought or required, the transactions assumed greater importance in the cost of the car. If competitive materials and methods showed technical and economic superiority, motor manufacturers could not afford to neglect them.

Cross-Examination

MR. KERSHAW, cross-examining, asked witness whether, if he found a faulty steel welded fabrication, he would scrap it, or whether he would find it easy to correct.

MR. BURNS replied that that would depend on the type of fault. If it showed signs of bad welding, it would probably be scrapped, for it must be assumed that the rest of the welding was equally bad as the part that could be seen. To the suggestion that it would be quite easy to cut it out and re-weld, he said that the cost would negative that.

As to the suggestion that one could not do much else than scrap a foundry "waster," he said it would depend entirely on the nature of the waster. Mr. Kershaw said he had in mind a waster which was deficient in metal in certain places, and he suggested that it could be built up by welding, or otherwise would be scrapped. Mr. Burns replied that it would be scrapped.

The PRESIDENT asked whether the welding rods used for salvage work were made in the foundry.

MR. KERSHAW replied that that was not necessarily so. But a rose by any other name would smell as sweet! The rods could be made in a steelworks by a wire-drawing process; but certain types of rods were supposed to be cast.

MR. TEMPLETON added that they were sometimes cast in iron foundries.

MR. KERSHAW said he assumed that practically all the castings on motor cars made by witness's firm were concentrated in the engine.

MR. BURNS replied that that was not so. A large percentage were on the chassis and the transmission.

The PRESIDENT said the jury wanted to know whether the company had any particular interest in developing the use of castings.

MR. BURNS replied that as an English unit it had a larger steel than foundry interest. The question was purely one of economics, combined with service to the public.

This concluded the case for the Plaintiff. The evidence for the Defence, the President's summing-up and the jury's verdict will be reported next week.

F.B.I. Business Forecast

The Federation of British Industries, in their "Business Forecast" for the first quarter of this year, state:—"The New Year finds business in very much the same condition as at the end of 1938. Industrial activity and employment have, on the whole, maintained the moderate levels established last autumn, but the lack of confidence in the political outlook is holding up fresh orders. Trade stocks appear in most cases to have been brought down to reasonable levels, so that the underlying condition is much healthier than it was at this time last year. There can be no doubt that if something could be done to restore confidence in the political field, there would be an improvement in world industry and commerce. At the moment, however, international trade shows little, if any, sign of reviving, and, apart from rearmament and defence, home trade is marking time, with a tendency to move to lower levels."

Iron and Steel Research

ANNUAL REPORT OF D.S.I.R.

The Annual Report of the Department of Scientific and Industrial Research,* just published, contains, as usual, references to the progress of research in the iron and steel industry during the past year. It points out that the Industrial Research Council of the British Iron and Steel Federation is approved by the Department for grant under the research association scheme. Its work came under review, during the year, by the Department's Advisory Council, whose chairman is Lord Riverdale. Through the medium of the numerous research committees of the Council, the report states, the services of the scientific and technical personnel of the industry are extensively used to effect a comprehensive co-ordination of all research activities, not only in the iron and steel industries themselves, but also in the steel-using industries with which there is collaboration.

An extensive scheme of research has been developed which has involved an increase in the annual expenditure from £11,124 in 1929 to £39,554 last year, and for the current year an estimated figure of £50,000. To encourage the Federation to expand still further the work of its Research Council, it has been offered grant assistance for the next five years which will provide a total annual sum of £60,000, if the necessary additional support from the industry is forthcoming.

Rolling-Mill Design

Research into rolling-mill design and operation has been begun. The work involves two aspects, namely, the engineering, concerned with the rolling mill as a machine, and the metallurgical, concerned with the plastic deformation of metals and its effect on rolling mill operation. Work on the production of materials for lightweight concrete produced by "foaming" blast-furnace slag, previously unsaleable, has been completed. The production of materials for heavier concrete from air-cooled slag is now being investigated.

The National Physical Laboratory is co-operating with the Research Council and the Iron and Steel Institute in investigating methods for measuring the temperature of liquid steel in open-hearth furnaces. The aim is to attempt to adapt the platinum thermo-couple and the optical pyrometer to the conditions of the open-hearth furnaces. Refractory materials have been found which will afford adequate protection to the measuring instruments when immersed for short periods in molten steel without slag, and in the next stage of the investigation an attempt is being made to obtain such slag-free conditions in an actual furnace as will enable the "quick-immersion" method to be brought into use.

Blast-Furnace Refractories

Under the Refractories Research Association, investigations have been made on bricks taken from the linings of blast furnaces. The deterioration occurring at different zones of a furnace due to the action of carbon monoxide, alkali salts, zinc and lead compounds, etc., has been examined. The results have indicated methods for producing firebricks which are resistant to the action of carbon monoxide. Suggestions have also been made regarding the composition of cements for joints between bricks in the various zones.

The British Cast Iron Research Association has now produced cast iron having a tensile strength of 60 tons per sq. in. Tests have been carried out at the National Physical Laboratory on crankshafts cast from materials supplied by the Research Association. Aluminium cast iron, the Report states, shows particular promise as a heat-resisting material.

* Published by H.M. Stationery Office, York House, Kingsway, London, W.C.2. (Price 3s. net.)

Examples of Loam Moulding

By R. D. LAWRIE

(*Concluded from page* 117.)

EXHAUST STEAM BEND

Fig. 12 shows a casting for a 90 deg. bend for exhaust steam, two of which were supplied to the order of a firm in the Midlands and installed in a Yorkshire city power station. The castings weighed 25 tons each and were moulded in loam from a skeleton pattern (Fig. 13). The foundry in which these castings were made has a river running alongside, and as there was no watertight pit available at the time it was decided to dry the mould in a stove. This necessitated the making of a bottom plate 20 ft. by 18 ft. by 6 ft., having provision for lifting and bolting.

Handling Arrangements

An examination of the pattern will show that the slinging of the mould demands more than the usual attention owing to the fact that the load is not uniformly distributed on the bottom plate. For this reason it was decided to make the bottom plate with lugs 12 in. square and at 12 in. centres all round the outside; by this means alternative lifts could be arranged, also provision for bolting prior to casting. The pattern being of the skeleton type of construction and therefore easily distorted, it was necessary to provide suitable bearings on which to rest the pattern.

Strickling Methods

Fig. 14 shows these bearings being swept up by a suitably-profiled board. The pattern was eventually laid on these various bearings, and on checking up was found to be perfectly level and free from distortion in any direction. Bricks and loam were built underneath the pattern to a height of three courses, the joints being packed with ashes to facilitate drying and venting; the top course in contact with the pattern was built solid, the open panels in the pattern simplifying this operation. At this stage six horizontal ingate patterns 4 in. by 1 in. were placed in position against the pattern so as to introduce metal at the cross ribs running underneath the pattern; 2-in. square downgates were placed to connect with these ingates, extending from the joint level down past the ingates for 3 in. or 4 in., so as to create a pool of metal.

From this point upwards it will be observed that the building assumes a new shape, consisting of two distinct sections, the larger section being of triangular shape having its outer walls at right angles to one another, whilst the inside assumes the curved contour of the pattern with the stool or base section projecting.

Pillar as Drawback

The smaller section is more or less an isolated pillar, and it was decided to build this in the form of a drawback for reasons which will be explained later. Building was carried up to the joint level, which was arranged where the pattern shape changes from the vertical to the circular. Building rings were placed at intervals of three courses, with reinforcing grids in all corners, soft loam bricks being built behind the flanges and at all points where contraction stresses were likely to be experienced. All joints over 4½ in. from the face of the pattern were filled with ashes, and in congested corners such as fillets straw ropes were introduced and led to the outside.

Making the Main Core

The building having reached this joint level, attention was turned to the main core. The main lifting iron for the core was of the box or girder type, 18 in. deep, and consisted of two parts so that they could be removed from the casting and used over again. Reference to Fig. 15 shows the smaller portion of the iron to have four rectangular arms, which are threaded through suitably placed holes in the larger section, being afterwards securely wedged together, and making an extremely strong and rigid core-iron.

For purposes of slinging and holding down the core, three rectangular lugs were cast on each print end of the core-iron, the outside lug

FIG. 12.—CASTING FOR 90-DEG. BEND FOR EXHAUST STEAM.

at each end being placed as far out as possible, so that the centre of gravity of the core should lie between a line joining these two outer lugs and the axis of the pattern. It was planned that the load would be carried by the two outer lugs at each end, and two additional slings carried up from lifting eyes in the heel of the main iron would look after the balancing or levelling of the load.

Fig. 16 shows the core slung in the manner already described. The core was built hollow,

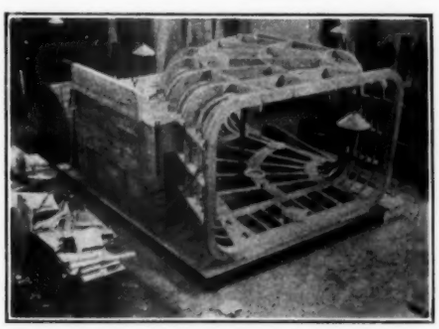


FIG. 13.—SKELETON PATTERN FOR BEND CASTING.

the main iron being packed with bricks and loam, side walls 12 in. thick, the top being covered by a grating with dabbers uppermost, 12 in. long. The top grating was supported at intervals on bricked pillars, 12 in. square. To assist in holding down the core during casting, a cast-iron bar, 8 in. square and 4 ft. long, was built in position on end, resting on the main core-iron and placed centrally with the 18-in. dia. hole in the top of the casting.

It was easily realised that the question of contraction in such a casting would require careful consideration, and that immediately the casting had set, steps would have to be taken to allow free and unhindered contraction to take place and prevent a possible fracture. To accelerate the easing of the core, slackening bars were built into the walls of the core near to the centre of their height. Along the longer radius this bar was in two parts, curved to suit the pattern and wedge shaped, 2 in. thick at the casting, tapering to 4 in. and 10 in. wide.

Along the shorter radius two similar tapered bars were built; these, however, were perfectly straight. In the centre of each supporting pillar a similar shaped wedge was built, 12 in. square, and provided with a mild-steel eye cast in the thicker side. Reference to Fig. 15 shows these slackening bars.

Making the Top Part

The core having been built, the joint was made and preparations for the top commenced. The top was actually in six sections, four of which carried the cope up level with the top ribs of the pattern, and bevelled down to the centre of the radius joining the top and sides of the pattern. The top-part proper was in two portions, two box-parts, 14 ft. by 9 ft. by 12 in. deep, being pressed into service for this purpose. The dividing line ran across the top to one side of the 18-in. dia. core, so that the centre of this core coincided with the last panel in one of the top boxes.

Grids were made to lift the various sections between the ribs in the top of the pattern, being toggled up through their respective top boxes. Ten flat gates, 3 in. by 1 in., were formed through the top, seven around the longer radius and three on the shorter radius, arranged to feed the metal down the mould thickness.

The building having been completed, the job was allowed to stiffen sufficiently to lift off the tops and turn them over; the four joint sections were removed, then the corner section between the prints at the axis of the pattern was lifted away, and the main core slung up. No trouble was experienced in lifting out the core and after one or two attempts a level sling was obtained. As soon as the core was floating evenly, it was moved away from the longer side of the pattern and lifted right out. The corner section was replaced and the remainder of the pattern drawn, the mould finished in the usual manner and lifted to the stove for drying.

The lifting lugs on the bottom plate proved of inestimable value in obtaining a level sling; by moving the chains off centre more on one side than the other the load was quickly balanced and transferred to the stove. After drying, the mould was lifted from the drying bogies and transferred to the casting pit. Referring to Fig. 13, it will be observed that the base or sole of the bend is built up solid and so requires coring out. There is a central web running horizontally through the sole, so that the core is in two portions, resting on prints at each end, the top half having a 16-in. dia. core cutting through the top thickness which serves to resist upward lift.

Coring up and Closing

Fig. 17 shows the cope of the mould with these two half-cores forming the sole in position and the joints made up. The main core was next lowered into position and presented no troubles beyond careful slinging. The four side drawbacks were next placed in position on the joint, being located by the usual system of marking. The first half top-part with the 18-in. dia. core bolted up into its print was now placed in position, a stamped joint being made between the 18-in. dia. core and the corresponding area on top of the main core. A 6½-in. square hole was carried through this core and the top-part.

The second half top-part was placed in position and completed the closing operation, after which all joints were daubed up and vents secured.

The next operation to be undertaken was that of binding. It presented several interesting problems which were overcome in the following manner. At each corner of the building special cast-iron corner plates were bedded in position, being connected by 1½-in. dia. bolts running horizontally from corner to corner; sixteen bolts were used, four on each side binding the mould securely together.

To hold down the top-part, four bars 12 in. by 6 in. by 20 ft. long were placed across the mould, two across each half box-part and connected to the bottom plate by 1½-in. bolts. Then the beam used to lift the cope and core was pressed into commission; it was turned upside down, the lifting links were unbolted and slid out to the ends and allowed to hang down, one on each side of the cope. This beam straddled the four cast-iron binding bars and was located directly above the centre of the 18-in. diameter core in the top-part, through which was passed a 6-in. diameter steel bar, making contact with the 8-in. square cast-iron pillar, which in turn rested on the main core-iron, as was previously explained.

An endless sling was passed over two separate lugs on the bottom plate and connected to the links of the beam by means of a shackle. Strain was applied to the middle of the large beam by the overhead crane, and wedges were driven between the beam and the four cross girders; finally the top of the 6-in. dia. bar was also wedged down securely. At each bearing of the main core, a slotted bar was placed across the three lifting lugs of the main core-iron and bolted down to the bottom plate. The mould having been securely bound, the pouring basins and risers were prepared. Thirty tons of metal were required to pour the casting and were contained in two 15-ton and one 4-ton ladle. The shape of the pouring head more or less follows the contour of the casting.

FIG. 14.—BEARINGS FOR SKELETON PATTERN IN PROCESS OF SWEEPING.

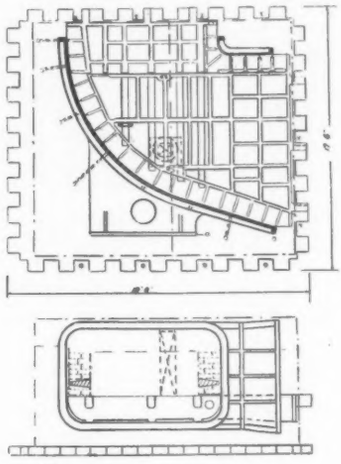


FIG. 15.—ARRANGEMENT OF BEND CASTING.

Gating and Casting

The outside row of gates connecting with the underside of the mould, 2 in. by 2 in., were the first to receive the metal, and when it was considered that the whole of the bottom of the mould had been filled, the inner row of gates (which up to this time had been kept plugged) were opened, and fresh metal allowed to drop down the side wall thickness. The section of the pouring basin serving the down gates round the shorter radius was isolated by means of a loam shutter, until it was considered that the metal was beginning to flow over the top of the main core; at this stage, pouring with fresh hot metal from the 4-ton ladle was commenced.

When this section of the basin was filled, the shutter was removed so that, if the smaller ladle should by any chance be emptied before the larger ones, the head would be maintained and dirt and scum be prevented from flowing into the mould. Risers were taken off each end of the main flanges, each end of the stool flange and the centre branch in the top.

Within a matter of two hours after casting, the pouring basin and runners had been broken, top binding-bars removed, and the top-part cleared of all sand and tackle.

Two gangs, each of four fettlers, now began the task of freeing the main core from the contracting metal. The internal pillars were first removed, the tapered blocks making this a comparatively simple job. Two baulks of timber were now placed in position, one at each end to support the top grating of the main core. Next the two slackening bars along the shorter radius of the casting were removed, using the overhead crane through the medium of a snatch-block and pulley. The brickwork in this area was removed from top to bottom so as to permit the smaller side of the casting to move in towards the large side.

Finally, the two slackening bars in the longer side of the core were removed, also by crane power. To complete the slackening operations, a chain was passed round the bottom of the timber baulks and a pull by the crane caused the top grid of the core to collapse, thereby freeing the casting in all directions. The ends were now covered in with sheets to prevent cold air entering, and after several days had elapsed the casting was dug out and fettled. Fig. 18 shows the casting during fettling.

The analysis was T.C, 3.42; Si, 1.92; Mn, 0.75; S, 0.087 and P, 0.21 per cent. The casting temperature was 1,280 deg. C. and the pouring time 160 secs.

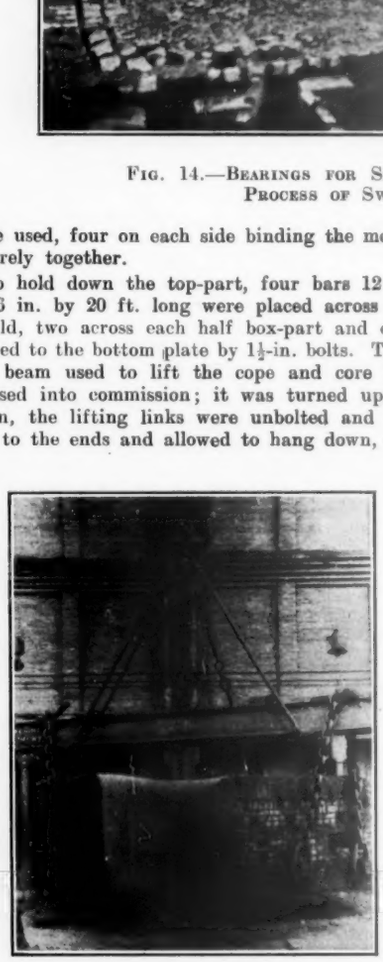


FIG. 16.—MAIN CORE SLUNG FROM THE SPECIAL LUGS.

FIG. 17.—COPE OF MOULD FOR BEND CASTING.

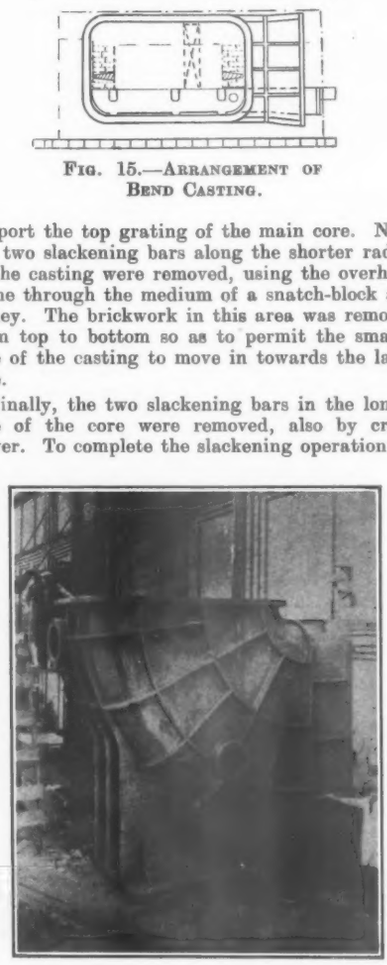


FIG. 18.—BEND CASTING DURING FETTLING.

Effect of Moisture on the Principal Properties of Moulding Sands*

By J. DEARDEN

In presenting this Paper, the writer feels it his duty to open it with an apology for adding to the large and possibly confusing volume of information already existing on the subject of moulding sands. It was this confusion of testing methods and results which led him to make his own experiments, and he hopes that the results will be of the same practical assistance to others.

This work was undertaken because it was thought that moisture is probably the most important variable in moulding sand, and certainly the easiest to control. The working moulder usually has no say in the choice of his sand, not even its grain size or its clay content, and he has to make the best use of whatever sand is provided. There are, however, two matters in which he can, and does, exercise his discretion; these are the moisture content of his sand, and the amount of ramming given to the sand when making the mould.

The Paper is chiefly confined to the effect of moisture on sand, especially from a moulding point of view. This is not because the effects of hard or soft ramming were considered of lesser importance, but rather because moisture content is more easily defined and measured. Determinations of moisture content were made with the "Speedy" moisture tester, the readings of which were occasionally checked by weighing samples of sand before and after drying.

The properties of moulding sands are influenced by a rather formidable list of variables, which include the size, shape, surface condition and distribution of the sand grains, the quantity and quality of the clay and its distribution by milling, the moisture content, and the degree of ramming applied to the sand whether in the form of a mould or a standard test-piece. The present Paper records the effect of moisture on samples of various sands, as measured under standard ramming conditions, irrespective of sand composition. Standard ramming conditions were obtained by use of the well-known A.F.A. drop-weight rammer, in which the ramming of the sand is independent of its composition.

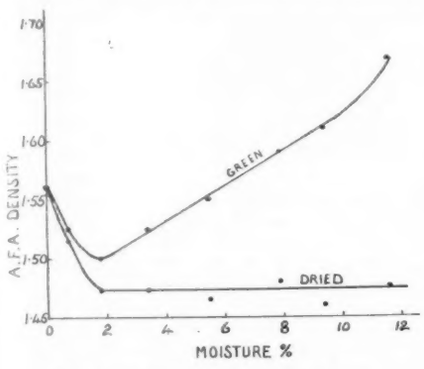


FIG. 1.—EFFECT OF MOISTURE ON DENSITY OF SOUTHPORT SAND.

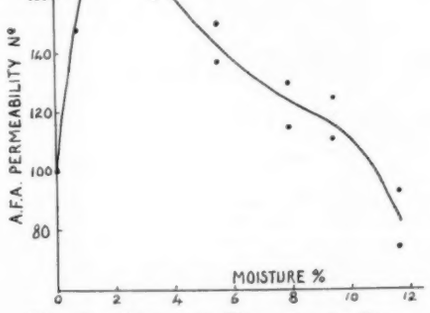


FIG. 2.—EFFECT OF MOISTURE ON PERMEABILITY OF SOUTHPORT SAND.

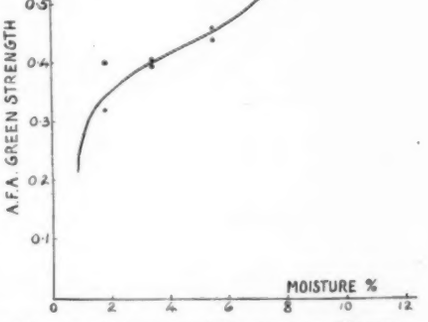


FIG. 3.—EFFECT OF MOISTURE ON GREEN STRENGTH OF SOUTHPORT SAND.

Tests on Sea Sand

The first series of tests was made on Southport sea sand. Being completely devoid of clay and silt, such a sand is free from the erratic effects due to variations in the quantity, quality and distribution of clay among the grains of ordinary moulding sand. It is thus possible to study the effect of moisture on the sand grains alone.

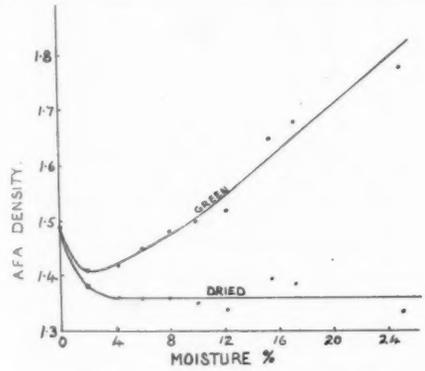


FIG. 4.—EFFECT OF MOISTURE ON DENSITY OF IRVINE SEA SAND.

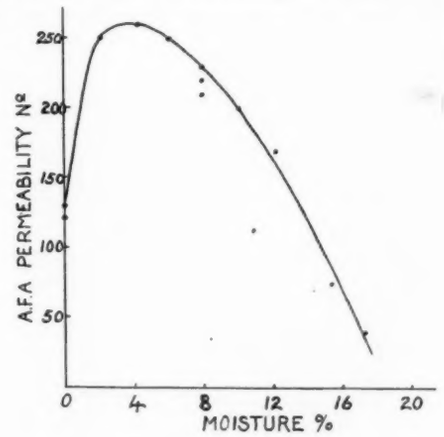


FIG. 5.—EFFECT OF MOISTURE ON PERMEABILITY OF IRVINE SEA SAND.

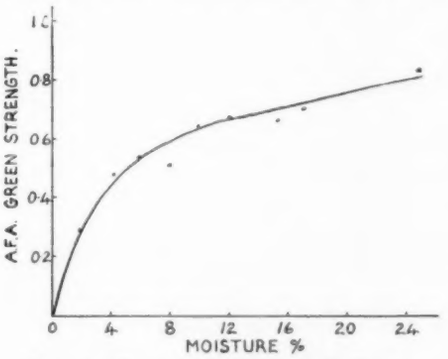


FIG. 6.—EFFECT OF MOISTURE ON GREEN STRENGTH OF IRVINE SEA SAND.

Fig. 1 shows the effect of increasing moisture on the A.F.A. density (*i.e.*, the apparent density of the sand test-piece when rammed by the three standard blows in the A.F.A. apparatus). The upper curve gives the density as rammed, and the lower one the density after allowance has been made for the moisture content. Above 2 per cent. moisture, the latter is virtually constant at 1.47, thus indicating that the increase in green density is due only to the increasing presence of moisture between the sand grains, and not to any closer packing of the grains themselves. There is a curious reduction in density as moisture increases from zero to 2 per cent.

Figs. 2 and 3 show the effect of moisture on the permeability and green strength of Southport sand. Increasing moisture above 2 per cent. gradually reduces the permeability by filling up the pore spaces between the grains. Sea sand is, of course, useless for moulding without a bond, but it is interesting to observe the gradual rise in green strength in Fig. 3, showing the slight bond afforded by the surface tension of the moisture between the sand grains.

At a later date these tests were repeated, using Irvine sea sand, which is coarser than Southport. The results are shown in Figs. 4, 5 and 6, from which it will be seen that the sand exhibits similar characteristics to Southport, although to a different degree. Here, again, there is a reduction in density as moisture is increased from zero to 2 per cent.; the author is unable to offer any explanation and would welcome discussion on this point.

Tests on Sea Sand with Clay

Having established the effects of moisture on pure sand, the next step was to study the same sand when bonded with a known amount of clay of known quality. This was done by milling Irvine sand with sufficient bentonite to form a good working bond.

The amount of bentonite added was 2.2 per cent., and it is interesting to compare the results with those obtained with Irvine sand alone, at 4 per cent. moisture in each case. Although there is no appreciable increase in density due to the presence of the bentonite, the permeability has come down from 260 to 165, owing to the fine particles of bentonite having swelled in the presence of the moisture. If this change had been brought about by the crushing of the sand

* Paper read before the Scottish Branch of the Institute of British Foundrymen, Mr. R. Ballantine presiding.

grains during milling, a marked increase in density would have been recorded. While sea sand has virtually no strength, the bentonite addition and the milling action have given it a green strength of 5.5 lbs. per sq. in. and a dried strength of 118 lbs. per sq. in. at 4 per cent. moisture.

The effects of increasing moisture on this mixture are shown in Figs. 7, 8, 9 and 10. Compared with Fig. 4, the lower curve of Fig. 7 now shows an upward tendency above 4 per cent. moisture, thus indicating that the increased green density is now no longer due to moisture alone, but also to a closer packing of the sand grains. This effect is considered to be due to the moist bentonite acting as a lubricant between the sand grains, as moisture alone is insufficient to cause it. Permeability rises to a maximum at about 4 per cent. moisture and then falls. The maximum green strength was found at about 2 per cent. moisture, but in this condition the sand was too dry for moulding purposes, and a moisture content of 3 to 4 per cent. would be more desirable.

The most remarkable effect of moisture in this case is on the dried strength, and Fig. 10 shows the phenomenal rise of this property with moisture; the dotted line shows the green strength on the same scale.

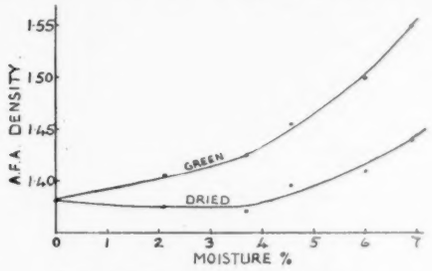


FIG. 7.—EFFECT OF MOISTURE ON DENSITY OF IRVINE SEA SAND MILLED WITH 2.2 PER CENT. BENTONITE.

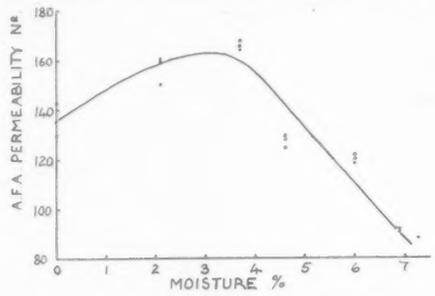


FIG. 8.—EFFECT OF MOISTURE ON PERMEABILITY OF IRVINE SEA SAND MILLED WITH 2.2 PER CENT. BENTONITE.

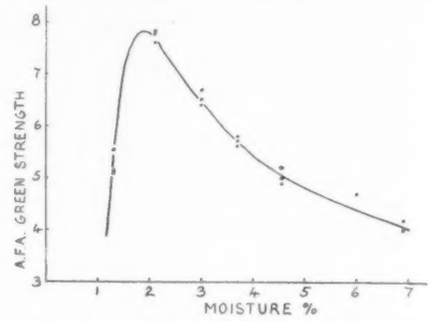


FIG. 9.—EFFECT OF MOISTURE ON GREEN STRENGTH OF IRVINE SEA SAND MILLED WITH 2.2 PER CENT. BENTONITE.

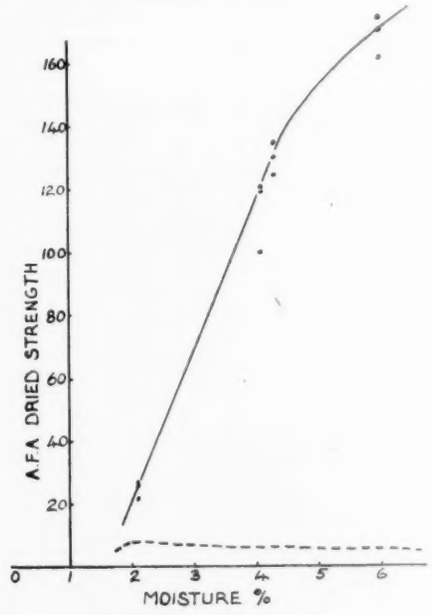


FIG. 10.—EFFECT OF MOISTURE ON DRIED STRENGTH OF IRVINE SEA SAND MILLED WITH 2.2 PER CENT. BENTONITE.

Tests on Raw Moulding Sands

Figs. 11, 12 and 13 show a similar series of tests on four raw moulding sands. These sands were tested as received, and without further milling. The results are representative only of the particular consignments of sand under test, but are roughly typical of their class. Their maximum green strengths are in the same order as their clay contents, and it appears that the higher the clay content, the greater is the variation in green strength due to moisture. It does not follow that the moisture content producing maximum green strength is also the best for moulding purposes, as the sand is then rather brittle and difficult to patch; a higher moisture is therefore to be preferred. Each sand has a maximum permeability, but not necessarily at the same moisture which gives maximum green strength.

The dried strengths plotted on Fig. 13 were determined on B.C.I.R.A. specimens rammed to the same green density as the corresponding A.F.A. green compression test-piece. This is because the only compression-test machine available at the time had a maximum capacity of 50 lbs., and that is much too low for breaking dried A.F.A. test-pieces. The dried strength is again acutely sensitive to moisture content, except in the case of Belfast sand, which was a red sand containing only 4 per cent. clay.

Tests on Facing Sands

This series of tests was made on the uniform sand circulating in a mechanised plant, and maintained at facing-sand quality for green-sand moulds. The quality was maintained by a 2 per cent. daily addition of raw sand, and sufficient coal-dust to maintain an 8 per cent. loss on ignition. The raw sand was of synthetic origin, the bond being a mixture of fireclay and ball clay. The results are plotted in Figs. 14 to 18, and exhibit features similar to those already noted in other sands, but differing in degree. The more important features are the rapid drop in green strength and permeability above 6 per cent. moisture, and the continuous rise in dried strength, although the latter is not so marked as with the bentonite sand of Fig. 10.

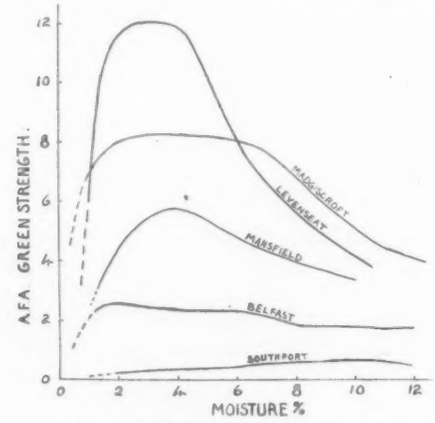


FIG. 11.—EFFECT OF MOISTURE ON GREEN STRENGTH OF RAW MOULDING SANDS.

Packing of Sand Grains

This question of increased packing of the sand grains when the moisture is raised above a critical value was investigated in several different sands, and the following conclusions drawn. Clay-free sands, such as sea sands and silica sands, do not pack closer with higher moisture. Red sands, such as Belfast, Stranraer, Mouldsworth and Mansfield, do so slightly or not at all, according to their clay contents. Sands high in clay content, such as Belgian red, Scottish rotten rock, and synthetic sands, especially if the last-named contain Colbond or bentonite, exhibit a closer packing of the grains above certain moisture contents. The inference is that this effect is due to the lubricating action of clay in the presence of moisture.

Fig. 18 has been included as a matter of interest. It shows the increase in green and dried strength of the plant sand obtained by harder ramming, the moisture being kept constant. It shows that one blow with an A.F.A. rammer is sufficient to give a dried strength of 30 lbs. per sq. in. in this sand, whereas 27 blows are required to attain this strength in the green state.

A comparison of the relative effects of moisture and ramming on dried strength can be drawn from Figs. 17 and 18. At 6.3 per cent. moisture, the dried strength of the plant sand is 54 lbs. per sq. in. To double the dried strength

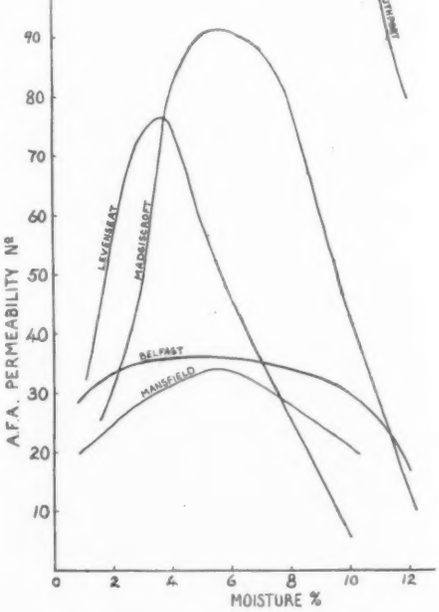


FIG. 12.—EFFECT OF MOISTURE ON PERMEABILITY OF RAW MOULDING SANDS.

by extra ramming, it is necessary to give 11 blows instead of the customary 3 blows. The same increase in dried strength can be obtained with 3 blows if the moisture is raised from 6.3 per cent. to 9.3 per cent.

Moisture Added After Ramming

As moisture has such a marked effect on the dried strength, it was decided to investigate the effect of its addition to rammed sand, as this is sometimes done during moulding. A.F.A. test-pieces were prepared and allowed to absorb

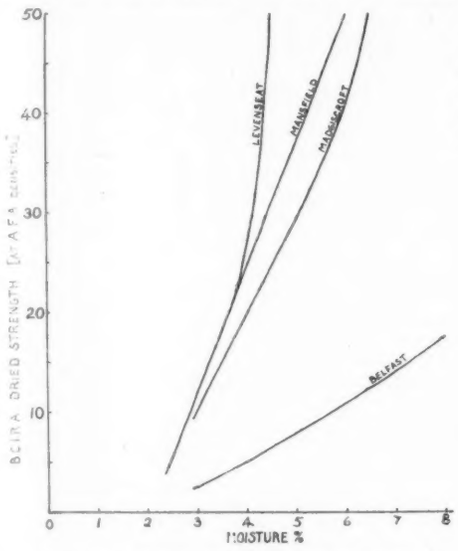


FIG. 13.—EFFECT OF MOISTURE ON DRIED STRENGTH OF RAW MOULDING SANDS.

increasing amounts of water, after which they were dried and tested under compression in the usual way. The samples of sand used were not identical with those quoted earlier in the Paper, but were adequate for the purpose. The results are given in Table I.

TABLE I.—*Influence of Moisture on Later Dried Strength.*

	Moisture added after ramming.	Total moisture.	A.F.A. dried strength.
	Per cent.	Per cent.	
Plant sand.	—	9	109
	3	12	99
	6	15	108
	9	18	108
Madgiscroft rock sand.	—	8.5	118
	3.5	12.0	114
	7.5	16.0	117

These results show that if moisture is added to raise the dried strength of a sand, it must be added to the sand before and not after ramming.

Control of Moisture Content

There are several reliable moisture testers available, but they do not indicate whether a sand is too wet or too dry for moulding purposes. This important question can only be settled by feeling the sand with an experienced hand. The case of Irvine sea sand bonded with bentonite is an illustration of this point. This sand was suitable for moulding when the moisture was about 3 to 4 per cent., but when it was in regular use in a mechanised plant, with sufficient coal-dust to maintain an 8 per cent. loss on ignition, the sand felt dry at 4 per cent. moisture, and it became necessary to raise the latter to 5 to 6 per cent. to develop sufficient plasticity in the sand. A possible explanation of this is that much of the coal-dust in the sand had become coked under the influence of the hot metal, and the extra moisture was absorbed by the pores of this coke, and by the fine particles of coal-dust.

In addition to the effect of coke, the working moisture content of a sand is affected by the grain size and the clay content; the finer the grain and the higher the clay content, the greater is the amount of moisture necessary. Hence, it is impossible to specify one moisture content for all sands, and each must be taken on its merits. Experience, coupled with a moisture tester, will decide what is the best moisture content for any particular sand. Then, provided the sand is controlled at a constant quality, the moisture tester can be used to ensure that this figure is being adhered to. Accurate determinations of moisture are necessary in order to decide whether variations in strength and permeability are due to moisture only, or to changes in sand composition. This applies particularly to dried strength, which is so sensitive

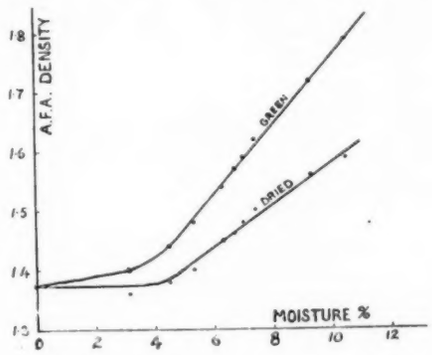


FIG. 14.—EFFECT OF MOISTURE ON DENSITY OF PLANT SAND.

to moisture that it is almost a measure of moisture content in itself.

Conclusion

The experiments described in the Paper show that each sand is a law unto itself so far as the effects of moisture are concerned, and test results should always be referred to the moisture content, as variations in the latter do have considerable influence on the properties of sands. Before it is possible to express an opinion on any sand, it is desirable that its characteristics

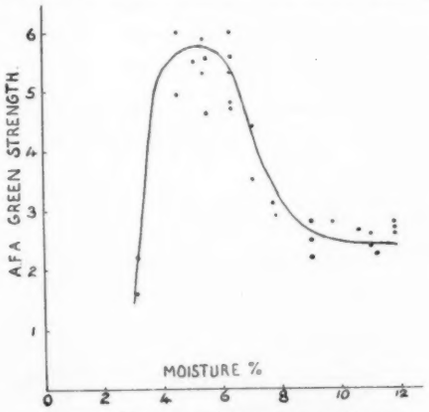


FIG. 15.—EFFECT OF MOISTURE ON GREEN STRENGTH OF PLANT SAND.

should be tested over a range of moisture contents.

From the moulding point of view, it may be stated that, within the usual range of moisture, increasing moisture gives a reduced permeability and green strength, but a much higher dried strength; it also makes the sand easier to ram, in which case there is a danger of the permeability being reduced even lower. Red sands are affected by moisture to a lesser extent than other and more heavily-bonded sands.

Some of the tests have been made at moisture contents which may appear absurdly low or high. This has been done solely with the intention of exploring the effects of moisture over as wide a range as possible. It is not suggested that these extreme values are of any use in moulding, but they have a scientific value in so far as they lead to a fuller understanding of the effects of moisture on sand.

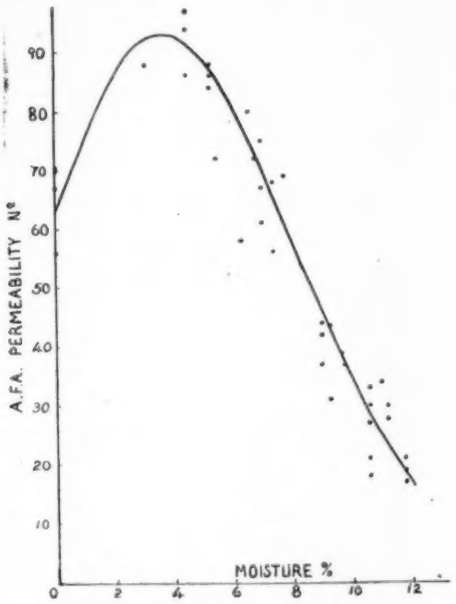


FIG. 16.—EFFECT OF MOISTURE ON PERMEABILITY OF PLANT SAND.

It has been noticed that the maximum green strength of raw moulding sands is developed at a lower moisture content than is required for facing sands which contain both used and unused coal-dust. This is probably due to a portion of the moisture being absorbed by the pores of the coke and the surface of the fine coal-dust, so that more is required to develop the maximum strength of the sand. This may provide an explanation for the statement that the use of coal-dust with a moulding sand raises the green strength. The working range of moisture is above that needed for maximum green strength, so that if coal-dust is used and the percentage of moisture kept constant, some of the moisture will be transferred from the clay to the coal-dust, and the green strength will rise.

If the moisture in the sand be controlled by the feel of the hand, this effect will not occur, as the moisture will be unconsciously raised to maintain the required degree of plasticity in the sand, as already explained.

The author wishes to thank the London Midland & Scottish Railway Company for permission to publish the information contained in this Paper.

DISCUSSION

The BRANCH-PRESIDENT (Mr. R. Ballantine) remarked that, whilst listening to Mr. Dearden's Paper, he had thought of a recent editorial in THE FOUNDRY TRADE JOURNAL, entitled "The Riddle of the Sands." He also recalled Mr. Hudson's Paper on facings, and he considered that facings were of more importance than the sands, and that if more attention were given to them, better results would be obtained. His experience had been that the Madgiscroft sand, with 6 per cent. moisture, gave the best results. He did not agree with Mr. Dearden as to the use of bentonite; he preferred to use 6 per cent. rock sand, which gave a better result because it made for easy compression when the contraction of the metal took place.

MR. A. L. MORTIMER asked for information about the two rock sands which had been dealt

with. He would like to know whether a difference in the type of sand affected the green strength, etc. The dry and green strengths of those sands had been given, but had the author any information about the sea sands after drying? If the sea sand had been bonded, would the permeability be affected?

MR. DEARDEN replied that it was not possible to test sea sand after drying out the water, because the test-pieces would fall to pieces. The permeability of dried sea sand should not change with moisture because the dried density was constant.

MR. W. BUCHANAN said, amid laughter, that he had already said and written so much on the subject that he was afraid that, without looking up his notes, he might contradict himself instead of the speaker.

The effect of putting water into sea sand had been dealt with, but he thought this served no useful purpose. The same applied to the very high and low moisture contents used. The normal range provided enough field for research. Water should be put into the clay where it would stay, and not separate round the grains or fill up the pores. The question of loam did not make any difference, as it was always dried.

He thought it would have been better to have taken a known volume of sand and then to have found out what happened on adding a known volume of water; but, as already stated, this would have no useful purpose. He had already shown that the A.F.A. test results were subject to a change of ramming as well as any change due to the water itself, and the conclusions could only be said to be "the effect of water on the A.F.A. test-piece" rather than its effect on moulding sands.

He was pleased to find Mr. Dearden carry out his own work and form his own conclusions, however, and if others did the same, it would undoubtedly be to the benefit of the industry.

MR. W. W. BRAIDWOOD thought it hardly fair to say that Mr. Dearden's work served no useful purpose. Mr. Dearden had asked for a possible explanation of the drop in density up to 2 per cent. water addition. He suggested that in the dry condition the sand was most able to flow, and a small water addition, by increasing the surface tension, prevented complete packing of the grains. After that amount had been added the water was in excess and the resistance to compaction was not further increased.

MR. J. E. O. LITTLE agreed with the idea of starting from pure sea sand, as it was always advisable, he said, to start at the base and go through the full range. He was pleased that Mr. Dearden had extended the water contents to the stage where the sands became extra wet, because that was important from the angle of loam moulding. Using wet loam was usually regarded as a safe method, but it could provide trouble, the same as other sands. He agreed with the President that facings deserved more attention, especially in regard to scabbing and buckling. In some work which Mr. Hudson had published it was shown that expansion at elevated temperatures was associated with buckling.

In this connection, Mr. Little said he had recently carried out some experiments which showed the clay content to be a very critical factor in scabbing. Also, the type of clay was important from the point of view of refractoriness in reducing atmospheres. He had made two green-sand moulds with loam cores; the cores were as nearly identical as possible, being made from the same batch of loam. One of the moulds was sleeked with plumbago, and with the other the plumbago was merely dusted on. The core loam was known to be prone to buckle, and the two castings showed a difference, in that with the sleeked mould the core did not buckle, but with the other it did.

The gases from the mould cavity were collected as the mould filled, and it was found that the sleeked mould gave 8 per cent. carbon monoxide, whilst the other gave 10 per cent. It would thus appear that even the small difference in the mould atmosphere, caused by the metal running on to a smoothed plumbago surface and a rough more or less unprotected surface, was sufficient to alter the performance of the loam of a core exposed to that atmosphere. In other words, the condition of the mould face could affect the performance of the core face from the point of view of buckling.

MR. T. TYRIE said it appeared that, in clay-bonded sand, there was a maximum point at

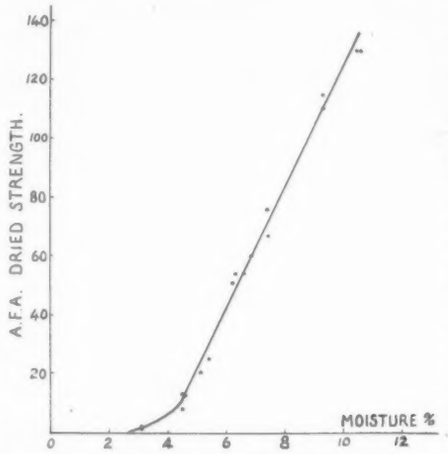


FIG. 17.—EFFECT OF MOISTURE ON DRIED STRENGTH OF PLANT SAND.

which the maximum green compression strength was reached, but apparently no maximum was shown in the case of the dry compression. He would be interested to know whether the author had found any maximum point after drying the bonded sand.

MR. DEARDEN replied that he had found no maximum in the dried-strength curve, but the green strength did definitely exhibit such a maximum. It might have been found if the moisture had been taken even higher, but very wet sand was not easy to ram because of its sticky condition. Mr. Braidwood's suggestion as to why

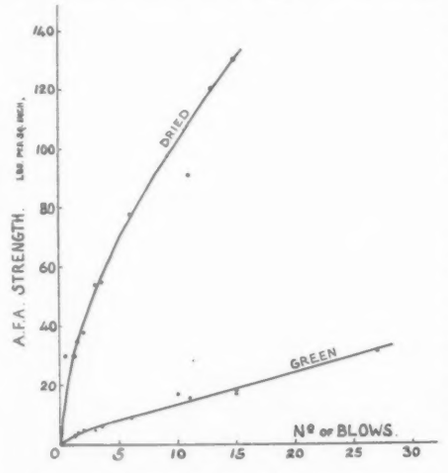


FIG. 18.—INCREASE IN DRIED AND GREEN STRENGTH OF PLANT SAND WITH HARDER RAMMING. MOISTURE CONSTANT AT 6.3 PER CENT.

the density of sea sand fell with moisture content up to 2 per cent. was welcomed. But was Mr. Braidwood right in thinking that it was entirely due to surface tension, or was it partly due to some other cause? The suggestion solved one problem, but set another, namely, why did the green strength of sea sand increase continually with increasing moisture if the surface-tension effect was at a maximum with 2 per cent. moisture?

British Standard Specifications

The British Standards Institution has issued a number of new and revised specifications dealing with pipe fittings, cast-iron conduit boxes, iron castings for gear blanks, and density composition tables.

Pipe Fittings.—With the publication of B.S. 143/1938, malleable cast-iron and cast copper alloy pipe fittings, the British Standards Institution has completed the revision of the specifications for long sweep malleable iron pipe fittings (B.S. 143/1922) and cast-iron pipe fittings (short turn pipe) (B.S. 154/1922), the two specifications now being incorporated in one publication. The general scope of the new specification has been amended by the inclusion of cast copper alloy pipe fittings and the exclusion of soft cast-iron pipe fittings that are to be the subject of a separate specification. Other amendments are the inclusion of additional patterns, the extension of the range of nominal sizes from 4 in. to 6 in. maximum and the inclusion of a section on testing the malleability and porosity. In addition the form of reinforcement of the ends of fittings is not now limited to a band, and alternative sizes are permitted within certain limiting dimensions.

Cast-Iron Conduit Boxes.—Up to the present the only conduit boxes for electrical wiring that have been regarded as British Standard have been those made of malleable iron or pressed steel, as prescribed in B.S. Specification No. 31. Many users, however, have used with satisfactory results boxes made of grey cast iron, and such boxes are recognised by the 10th edition of the I.E.E. Wiring Regulations provided they comply with certain dimensions and tests. With a view to remedying this inconsistency between the Wiring Regulations and the British Standard Specifications for wiring materials, a B.S. Specification for grey cast-iron conduit boxes has now been published (B.S. 820). The Committee responsible for this Specification realised that many of the patterns of grey cast-iron boxes are definitely unsatisfactory for good-class installations owing to their liability to fracture, and are therefore unworthy of being regarded as British Standard. A series of tests were therefore carried out with a view to eliminating the unsatisfactory patterns, and the new Specification has been drawn up on the basis of these tests. The Specification recognises three sizes of small circular boxes, and lays down full details of the dimensions, screw threads, and mechanical tests.

Iron Castings for Gear Blanks.—The B.S. Specification for iron castings for gears and gear blanks covers three grades of material, as follows:—Ordinary grade (for use in the as-cast condition) the composition of which is left to the discretion of the manufacturer, but the maximum percentage of phosphorus may be specified by the purchaser, if he so desires. Medium grade (also for use in the as-cast condition), the phosphorus and sulphur contents being limited to 0.60 and 0.12 per cent. respectively. High grade (for use in the as-cast or heat-treated condition), with phosphorus and sulphur contents of 0.30 and 0.12 per cent. respectively. For this latter grade the use of alloying elements, nickel, chromium, molybdenum, etc., or appropriate combinations thereof, especially for heavy sections, is recommended. Four sizes of standard test bars are provided, and the figures for the tensile and transverse breaking strengths for all three grades are based on the size of test bar used.

Copies of these B.S. Specifications may be obtained from the British Standards Institution, 28, Victoria Street, London, S.W.1. (Price 3s. 6d. each for Nos. 143, 823 and 824, and 2s. net for Nos. 820 and 821.)

Of interest to Pig Iron Users

THE STANTON METALLURGICAL SERVICE

The Stanton Company believe that a mutual policy of collaboration in more scientific and better methods of manufacture, can do much to widen the field for cast-iron products.

The Stanton Company therefore offer to all those engaged in the Iron Foundry Trades the free advisory service of specialists in metallurgical practice and technique.

This service takes the form of analyses and tests by the Company's Research Department on castings submitted to them, and constructive suggestions if the desired results are not being attained.

Where there are difficulties in works practice which can best be investigated on the spot, the service provides for a personal visit from a Stanton metallurgical expert, who will collaborate with the foundry staff.

THE STANTON IRONWORKS COMPANY LIMITED
Near NOTTINGHAM

The Largest Producers of Foundry Pig Iron (for Sale) in Great Britain

The Week's News in Brief

Trade Talk

THE RUNNING-IN of the new Ebbw Vale plant of Richard Thomas & Company, Limited, is expected to be completed by the end of this month.

DEPOSITS of diatomite which have been discovered in the Isle of Skye are said to be of high quality and to amount in quantity to half a million tons.

COX & DANKS, LIMITED, iron and steel and scrap merchants, have enlarged their premises at Hurlingham Wharf, Carnwath Road, Fulham, London, S.W.6.

A RECEIVING ORDER has been made in connection with the affairs of Mr. Arthur E. Bach (trading as The Brearley Foundry Company), 57, Brearley Street, Birmingham, ironfounder.

SWAN-HUNTER & WIGHAM RICHARDSON, LIMITED, the Wallsend shipbuilders, to-day are employing more men than at any other time in their history. This is due to the large amount of naval work in hand.

TO FINANCE EXTENSIONS to plant and buildings, the directors of Aeroplane & Motor Aluminium Castings, Limited, propose to create and issue 100,000 new ordinary shares of 4s. The amount receivable by the company in respect of the issue will be £26,250.

FIREMEN HAD to fight for four hours before they finally subdued an outbreak of fire which occurred last Saturday night in the electro-plating works of the Scottish Enamelling Company, Limited, and the Larbert Art Metal Company, Limited, Larbert. The fire caused considerable damage to plant and buildings.

UNDER the sliding scale agreement the Cleveland blast-furnacemen and ironstone miners are to receive an advance of 1½ per cent. in wages, which will increase the district percentages payable on the base rates to 51.52 per cent. at the blast-furnaces and 42.75 per cent. at the mines. In the case of the blast-furnacemen the advance is operative from February 5 and for the ironstone miners from February 14

JOSHUA BIGWOOD & SON, LIMITED, engineers and ironfounders, of Wolverhampton, have purchased the goodwill, including all drawings, patterns, jigs, tools, records and work in progress, of the general purpose lathes made by the Britannia Lathe & Oil Engine Company, Limited, of Colchester. These lathes range from 4½-in. to 9-in. centres and will in future be made at Joshua Bigwood's works in Wolverhampton. The general design of these machines is being improved, but Joshua Bigwood will be able to supply spare parts for all previous models of the Britannia Lathe Company's machines.

Personal

MR. W. ELLES-HILL has been appointed a director of the Saturn Oxygen Company, Limited, in place of the late Mr. Sidney Allen.

MR. R. G. BLAKE has been appointed a director of the Staveley Coal & Iron Company, Limited, in place of the late Mr. Robert Whitehead.

SIR HAROLD CARPENTER, a past-president of the Institute of Metals, is to receive the Institute's medal at the annual meeting on March 8-9.

MR. H. T. WINTERTON, manager of the Chesterfield Branch of William Cumming & Company, Limited, has been elected a director of the company.

MR. JOHN CRAIG, C.B.E., has attained his jubilee with Colvilles, Limited, of Motherwell. To mark the occasion he was presented by the workmen with a silver salver.

MR. W. S. B. BOSANQUET, general manager of the Skinningrove Iron Company, Limited, up to 1936, has been appointed chairman and managing director of the firm as from March 1.

MR. R. T. SMITH, of W. H. Smith & Company (Whitchurch), Limited, ironfounders, of Whitchurch, Salop, is retiring from the local bench of magistrates, of which he has been a member for 30 years.

MR. ERNEST SCOTT has retired from the position of manager of the blast furnaces at Holwell Ironworks, Asfordby. Altogether Mr. Scott has served the Holwell Iron Company, Limited, for 48 years.

MR. A. C. BERNARD received a presentation from senior members of the staff of Carron Company's engineering department, on the occasion of his leaving the company to take up an executive position with the Steel Company of Scotland, Limited, Glasgow.

A RECORD of 67 years' service with William Cross & Sons, Limited, Lyng Foundry, West Bromwich, by Mr. J. J. Richards, who during that time rose from office boy to director, was honoured on Wednesday last week at a dinner, which was attended by the directors of the firm and the heads of the office. Mr. Richards was presented with a radiogram and a fireside chair by Mr. John Cross, the managing director.

Wills

TIMMINS, C. H., of Solihull, retired brass-founder £1,249

WHEATLEY, WILLIAM, of Wickham (Hampshire), engineer and ironfounder ... £25,758

Obituary

THE DEATH has occurred recently of Mr. John J. Jones, a member of the board of John Jones & Sons, Limited, Britannia Foundry, Loughborough.

MR. EDWARD JOHN BOLTON has died at his home at Wrexham, at the age of 51. He was a director of Thomas Bolton & Sons, Limited, smelters and refiners, of Widnes, Lancs.

MR. SAMUEL KIRKPATRICK, for many years secretary and a director of Harrison & Company (Lincoln), Limited, Hykeham Works, near Lincoln, has died at the age of 58.

MR. ARTHUR HARRIMAN MOSS, managing director of Ernest Newell & Company, Limited, colliery engineers and ironfounders, Misterton, Doncaster, has died at the age of 65.

WE REGRET to announce the death of Mr. Kenneth Hill, a prominent member of the Institute of British Foundrymen and of the Institute of Vitreous Enamellers, of the latter of which his wife, formerly Miss Christine Elliott, is honorary secretary. Mr. Hill was only 36 years old, and within recent years set up in business on his own account as a chilled-iron grit merchant. At the moment his firm is equipping a factory for manufacturing this article. He served his apprenticeship with Thomas Perry & Sons, Limited, of Bilston, and later had appointments in his father's firm, A. C. Hill, Limited; the Chillington Tool Company, and Harrisons (England), Limited, of Middlesbrough. During the war Mr. Hill served as an officer in the Royal Navy, being twice wounded, and leaving the service with the rank of sub-lieutenant. To his widow we offer our deepest sympathy on behalf of the foundry industry and the vitreous enamelling trade. The funeral will be at Golders Green Crematorium to-morrow (Friday) afternoon at 3 p.m.

MR. RICHARD STEPHENSON MIDDLETON died in a nursing home in Newcastle-upon-Tyne on Saturday, January 28, aged 70. He was deputy-chairman of Richardsons Westgarth & Company, Limited, and chairman of S. P. Austin & Son, Limited, shipbuilders.

WE REGRET to announce the death of Mr. A. J. J. Arnold, managing director of Joseph Arnold & Sons, Limited, sand quarry owners, of Leighton Buzzard. Mr. Arnold was a Past-President of the Refractories Association of Great Britain and a member of the Institute of British Foundrymen since 1929. At the funeral, which took place at Leighton Buzzard last Tuesday, the Institute was represented by Mr. W. J. Rees, of Sheffield University.

Applications for Trade Marks

The following list of applications to register trade marks has been taken from the "Trade Marks Journal":—

"GUSSOLITE" (DEVICE). — Metals. François Cementation Company, Limited, 701, Salisbury House, London, E.C.2.

"STARITE."—Non-ferrous and grey-iron castings. Star Foundry Company, Limited, Batman's Hill Road, Bradley, Bilston.

Contracts Open

Bromley (Kent), February 13.—Castings, etc., for 12 months from April 1, for the Borough Council. Mr. Harold Cliffe, borough engineer, Municipal Offices, Bromley, Kent.

Chester, February 20.—Iron fencing and ironwork during the year ending March 31, 1940, for the Cheshire County Council (County Roads and Bridges Committee). The County Surveyor, Watergate House, Watergate Street, Chester.

Colne, February 18.—Iron castings for 12 months from April 1, for the Borough Council. The Borough Engineer, Town Hall, Colne.

High Wycombe, February 27.—Iron castings, iron pipes, etc., for the year ending March 31, 1940, for the Borough Council. Mr. J. A. Parkinson, borough surveyor, Municipal Offices, High Wycombe.

Leeds, February 13.—Iron castings for 12 months, for the Waterworks Committee. Mr. H. Shortreed, waterworks manager, Waterworks Department, Civic Hall, Leeds, 1.

London, W., February 22.—Iron castings for 12 months from April 1, for the Ealing Borough Council. Mr. C. W. Seddon, Surveyor, Town Hall, Ealing, London, W.5.

Salford, February 13.—Iron castings, for the City Council. The City Engineer, Town Hall, Salford, 3.

New Companies

(From the Register compiled by Jordan & Sons, Limited, Company Registration Agents, 116 to 118, Chancery Lane, London, W.C.2.)

W. Robinson & Company (Sheffield), Limited.—Capital, £5,000. Ironfounders. Director: W. R. Robinson, 53, Handsworth Road, Sheffield.

Marsh & Wynne, Limited.—Capital, £3,000. Engineers, &c. Directors: R. H. Marsh, Hazeldene, Rixon, Sturminster Newton, Dorset; E. V. Wynne.

Oliver Ashworth (Bury), Limited, Castle Grounds, Bury, Lancs.—Capital, £2,000. Machinery and metal merchants. Directors: O. Ashworth and A. Metcalfe.

O. R. Engineering Company, Limited.—Capital, £2,000. Directors: O. Rosenfelder, H. A. Rosenfelder and E. Weber. Subscriber: E. Smith, 10, Norfolk Street, London, W.C.2.

Forthcoming Events

FEBRUARY 15.

Manchester Metallurgical Society:—Open discussion on Apparatus Used in Modern Metallurgical Research, with exhibits, at Blackfriars House, Blackfriars Street, Manchester, at 7.15 p.m.

FEBRUARY 17.

Institution of Mechanical Engineers:—Annual general meeting, at the Institution, Storey's Gate, London, S.W.1, at 5.30 p.m.

Institute of British Foundrymen

FEBRUARY 13.

Lincolnshire Section:—"More Non-Ferrous Foundry Problems," Paper by F. Dunleavy, at Lincoln Technical College, at 6.45 p.m.

FEBRUARY 14.

Burnley Section:—"Production of Certain Iron Castings," Paper by J. Roxburgh, at Municipal College, Burnley, at 7.30 p.m.

FEBRUARY 15.

Lancashire Branch:—"Manufacture and Application of Grinding Wheels," at Engineers' Club, Manchester, at 7.30 p.m.

FEBRUARY 16.

East Anglian Section:—"Modern Coreshop Production," Paper by W. H. Smith, at Central Library, Ipswich, at 7.30 p.m.

FEBRUARY 17.

Middlesbrough Branch:—"Fifty Years' Progress in Steel Moulding," Paper by F. Swift, at Cleveland Scientific and Technical Institution, Middlesbrough, at 7.45 p.m.

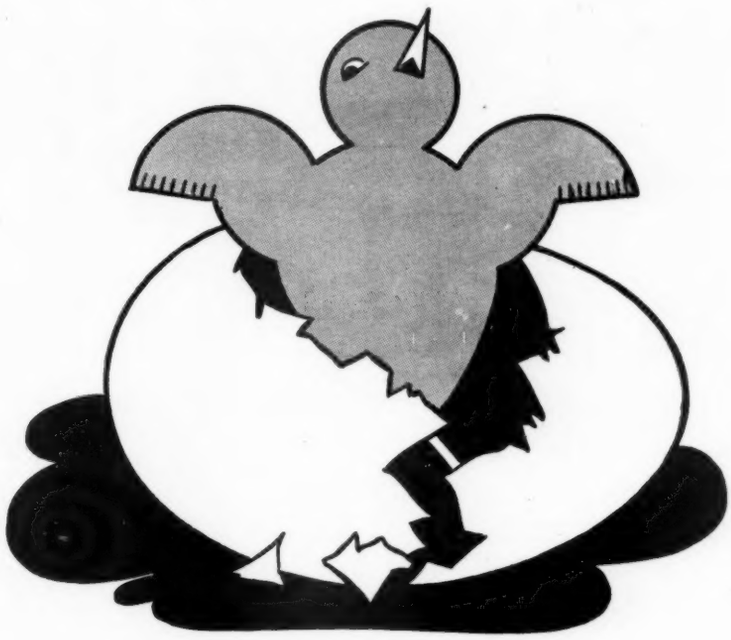
FEBRUARY 18.

Bristol Section:—"Light Castings and Their Manufacture," Paper by A. Burgess, at Merchant Venturers' Technical College, Bristol, at 7 p.m.

The Institute of Vitreous Enamellers

FEBRUARY 16.

Midland Section:—"Hollow-ware and Signs," Paper by W. S. Grainger, at Chamber of Commerce, New Street, Birmingham, at 7.30 p.m.



EASTER REPAIRS

Winter is drawing to a close and with the awakening Spring come thoughts of the garden, the open road, holidays—time too, to think of Easter repairs.

Orders placed now for Firebricks, Silica Bricks, and Basic Bricks, etc., can be executed in time for your Easter repairs, enabling you to avoid the delay and disappointment which often accompany last-minute demands for supplies, so in your own interests order NOW.

Our Technical Staff is at your service for advice on any problem regarding the selection of the correct grade of refractories to meet your exact needs

A FEW OF OUR PRODUCTS

FIREBRICKS	SILICA BRICKS	BASIC BRICKS
GLENBOIG	LOWOOD	SAXPYRE
WHITE CARR	ALLEN	SPINELLA
HALIFAX	MELTHAM	DIAZITE
STOUR	BAWTRY	SUPERMAG

AMBERLITE INSULATING BRICKS, CEMENTS AND CONCRETES, ACID RESISTING BRICKS AND CEMENTS, REFRACTORY CEMENTS AND SANDS OF EVERY DESCRIPTION

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Raw Material Markets

February has opened with the iron and steel markets very quiet and disappointing. Business in January was much below what producers had anticipated would have been the case, and it cannot be said that there is any real promise of improvement in the near future. The lower prices which came into operation on January 1 did little to encourage buyers to make forward contracts, and trade generally is confined to small tonnages for early delivery.

Pig-Iron

MIDDLESBROUGH.—Local foundries are still working unsatisfactorily and delivery specifications are at a low ebb. Producers' stocks have been brought down to reasonable proportions, and the output is being restricted in order that demand and production may be evenly balanced. No doubt, the unsettled international situation has had a lot to do with the absence of forward business, and it is believed that Herr Hitler's speech to the Reichstag will to some extent improve the position, although there has certainly been little change so far.

The hematite market is now more active, but there is a long way to go before the position becomes really satisfactory. Makers have heavy stocks to dispose of, and these will have to be sold before any question of higher outputs can be considered. Steelworks in this area are calling for increased tonnages under contract, while there has recently been a better demand from the South Wales works. The export demand remains an unsatisfactory feature of the market, and the call for supplies from overseas is very small. The price of East Coast mixed numbers for delivery on the North-East Coast is 120s., 125s. 6d. in Sheffield, and 131s. in the Midlands, less 5s. per ton rebate.

LANCASHIRE.—Although a few replacement orders are being received in the foundry iron market, these are generally for small tonnages, and the outlook is not at all satisfactory. Consumers under contract are not calling for full deliveries, but the position in this respect has certainly improved as compared with the last few months of 1938. Engineering concerns connected with the rearmament programme are better situated for orders than other sections, most of which remain on short time. For delivery to consumers in the Lancashire price zone, offers of Derbyshire and Staffordshire brands of No. 3 iron are on the basis of 104s., with Northamptonshire No. 3 at 102s. 6d. Derbyshire forge iron is from 101s. to 103s. per ton. New business in hematite is still quiet, but there has been a quickening in the call for deliveries under contracts.

MIDLANDS.—Light-castings and jobbing foundries continue to take up high-phosphorus iron rather slowly; there has been some improvement as compared with the later months of last year, but reduced quotations have not done much to bring forth new orders. In many cases where consumers' stocks have been exhausted, orders are being placed, but the tonnages involved are small and for prompt delivery. The building trade continues to be rather depressed, but it is hoped that the anticipated improvement in this section in the spring will be reflected in brighter conditions among the light-castings industry. The heavy engineering concerns, which are mostly engaged on Government work, are busy and are taking up heavy supplies of low-phosphorus iron. The turnover in this material is satisfactory. No control is exercised over prices, which range from £5 5s. to £6 7s. 6d. per ton. Owing to the higher transport costs, the latter figure is quoted for Scotch iron. Being well covered by existing contracts, hematite users are not buying very freely, but there has recently been a noticeable quickening in the call for deliveries, and the outlook is improving. East Coast No. 3 hematite is quoted at 131s., with West Coast material at 132s., both less 5s. rebate.

SCOTLAND.—There is no improvement to report in the condition of the foundry iron market in this area, and new business is confined to small tonnages for early delivery. Consumers cannot be induced to buy forward, and are content merely to cover their immediate requirements. No. 1 foundry iron is quoted at 108s., and No. 3 at 105s. 6d., f.o.t. furnaces. Short time continues to be general among the light-castings trade. Local steelworks are not in the market for further supplies of iron, as they are mostly well covered ahead. Quotations for steel-making irons are:—Hematite mixed numbers, 120s. 6d.; basic iron, 92s. 6d., both less 5s. rebate, delivered local steelworks.

Coke

There is a fairly good demand for industrial qualities of coke, while the call for domestic grades has been increased as a result of the colder weather. There has been a number of orders from ironfounders for delivery during the second quarter, but business is mostly confined to the first quarter. For delivery in Birmingham and district, the minimum price of both Durham and Welsh cokes is 50s. 6d. per ton.

Steel

While there is a good demand for certain descriptions of steel from the Government in connection with A.R.P. work, civil orders are difficult to procure. As a result, many of the works are still working short time. Air-raid shelters are accounting for the consumption of large tonnages of sheets and makers of these are operating at a better level now than has been the case for a long time past. Small steel bars and strip are being taken up in heavier tonnages, while semi-finished material is also more active.

Scrap

Although the iron and steel scrap market is still far from active, there has been a steady improvement during the past week or two. Under the stimulus of the A.R.P. work, many steelworks are operating at a better level, and the demand for scrap from this source has improved materially. However, as yet this has not resulted in much new business, as many of the works are already behind schedule in their contract commitments.

Metals

Rather firmer conditions have prevailed in non-ferrous metals during the past week, and, if anything, business has been slightly heavier. Nevertheless, trade is expected to continue on a hand-to-mouth basis until the political outlook is clearer.

Copper.—There has been a moderate demand for this metal, but consumers are still reluctant to commit themselves ahead. Refined metal has certainly been in better request. The requirements of the armament makers continue to be on a good scale, but other consumers are not well placed and are satisfying their needs as they arise.

Metal Exchange quotations were as follow :—

Cash.—Thursday, £42 17s. 6d. to £42 18s. 9d.; Friday, £42 16s. 3d. to £42 17s. 6d.; Monday, £43 3s. 9d. to £48 5s.; Tuesday, £43 1s. 3d. to £43 2s. 6d.; Wednesday, £42 10s. to £42 11s. 3d.

Three Months.—Thursday, £43 2s. 6d. to £43 5s.; Friday, £43 2s. 6d. to £43 3s. 9d.; Monday, £43 8s. 9d. to £43 10s.; Tuesday, £43 7s. 6d. to £43 8s. 9d.; Wednesday, £42 16s. 3d. to £42 17s. 6d.

Tin.—Featureless conditions remain in evidence in this market, and buyers are not displaying much confidence in the future. The outlook was brightened to some extent by recent political utterances, but it is appreciated that something more is needed before international relations in the commercial world return to their former position of security.

In a leading article recently, "The Straits Times" expressed the opinion that it had now become clear that the fears expressed with regard to the buffer pool were fully justified, and added that references to American consumption only touched the surface of the problem. The newspaper estimated the available supplies of tin at more than 55,000 tons—visible supplies plus pool supplies—and declared that the position was very little better than that ruling during the worst depression of 1931-32. If the pool authorities could not persuade consumers to exchange their perfectly natural antipathy to the scheme for a very substantial degree of co-operation, the outlook for the producer in the coming year was very dismal, the article stated.

The monthly tin statistics compiled by Mr. W. H. Gartsen (Henry Rogers, Sons & Company) are disappointing and indicate that the total visible supply of tin on January 31 was 21,924 tons, as compared with 20,898 tons on December 31, and 16,831 tons on January 31, 1938. The carry-over in the Straits Settlements was 9,065 tons (6,947 and 6,133 tons), while the carry-over at the Arnhem (Holland) smelter was 1,959 tons (1,649 and 2,003 tons).

Official quotations were as follow :—

Cash.—Thursday, £215 5s. to £215 10s.; Friday, £215 2s. 6d. to £215 5s.; Monday, £215 7s. 6d. to £215 10s.; Tuesday, £215 10s. to £215 15s.; Wednesday, £213 15s. to £214 5s.

Three Months.—Thursday, £214 5s. to £214 10s.; Friday, £214 to £214 10s.; Monday, £214 17s. 6d. to £215; Tuesday, £214 5s. to £214 10s.; Wednesday, £212 10s. to £212 15s.

Spelter.—Unfortunately, the chief source of activity in this market appears to have quietened down to some extent. Until recently the galvanisers were placing substantial orders for supplies of zinc required in connection with the Government's air-raid shelter programme, but there has been a pronounced falling away of late. Consequently, the market has been very dull and business has been at a low ebb.

Daily market prices :—

Ordinary.—Thursday, £13 11s. 3d.; Friday, £13 10s.; Monday, £13 12s. 6d.; Tuesday, £13 11s. 3d.; Wednesday, £13 7s. 6d.

Lead.—There has been little support for this metal during the week, and trade has been very quiet. It is hoped that Continental orders will be forthcoming shortly, and if this proves to be the case, a better tone should develop.

Day-to-day quotations :—

Soft Foreign (Prompt).—Thursday, £14 5s.; Friday, £14 6s. 3d.; Monday, £14 6s. 3d.; Tuesday, £14 7s. 6d.; Wednesday, £14 5s.

Scrap.—Stocks of scrap metal at consumers' works appear to be on the heavy side, and there has been little incentive to purchase additional tonnages. Business is, in the main, confined to forward contracts, which are being arranged at low quotations.

Approximate selling prices for old metal:—New aluminium cuttings, £70; rolled, £54 to £55; cast, £32; foil, £80. Copper, £38 to £43; braziery, £35. Brass (clean), £21 to £25. Zinc, £10. Lead, £13 7s. 6d. Gunmetal, £38.

Company Reports

Warner & Company, Limited.—Dividend due on the 6 per cent. cumulative preference shares has been passed.

Herbert Morris, Limited.—Half-year's dividend to January 31 on the 5 per cent. (free of tax) cumulative preference shares.

Glacier Metal Company, Limited.—Half-yearly dividend to February 28 on the 5½ per cent. cumulative preference shares.

C. Akrill & Company, Limited.—Dividend on the ordinary shares for the twelve months ended December 31 of 10 per cent., free of tax.

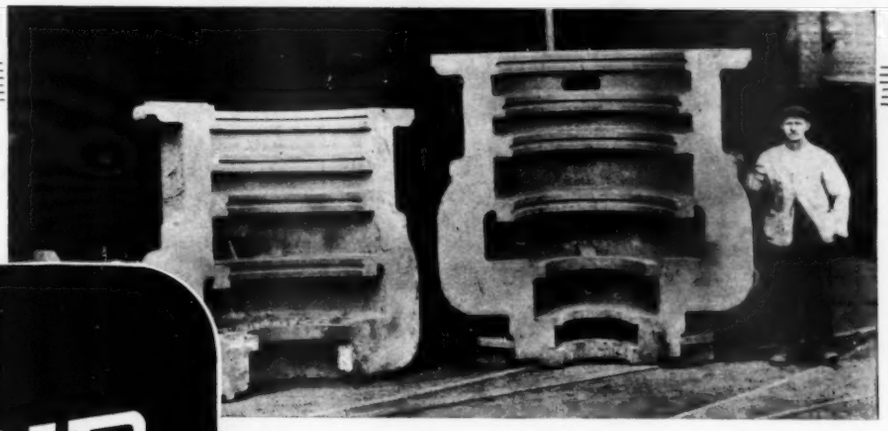
Braithwaite & Company, Engineers, Limited.—Interim dividend of 2 per cent. on the ordinary shares on account of the year ending March 31 next.

Shanks & Company, Limited.—Profit for 1938, £54,538; brought in, £33,377; final dividend of 7½ per cent., making 10 per cent.; to special depreciation, £10,000; carried forward, £44,251.

MAGNETIC SEPARATORS
for the Foundry
"RAPID-BIAFLUX"
(Patent)
PULLEYS & DRUMS
The Popular "OVERBAND"
LISTED IN 5 SIZES
LIFTING MAGNETS FOR PIG IRON & SCRAP
THE RAPID MAGNETTING MACHINE CO. LTD.
MAGNET WORKS, LOMBARD ST.
BIRMINGHAM, 12

ON ADMIRALTY, WAR OFFICE, AIR MINISTRY, LLOYDS AND OTHER APPROVED LISTS

PHONE : DARLASTON 225 (3 lines)
GRAMS : STEEL, DARLASTON



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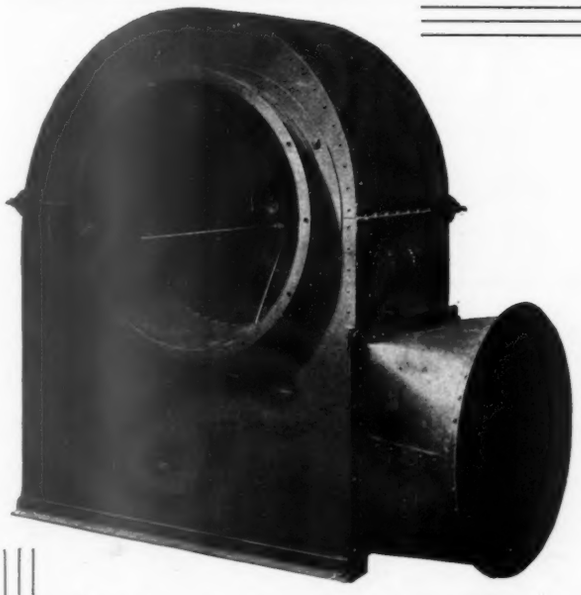
STEEL CASTINGS

FROM A FEW OUNCES UP TO

25 TONS

FOR ALL INDUSTRIES

JAMES BRIDGE STEEL WORKS, near WEDNESBURY



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TRADE SIROCCO MARK

PRODUCTS

Embody over half a century's accumulated experience in Fan and Allied Engineering

'SIROCCO' AND 'AEROTO' (TRADE MARK) FANS (THE MOST COMPLETE RANGE EVER MARKETED BY A SINGLE ORGANISATION).

'DAVIDSON' (Trade Mark) patent DUST AND FLUE DUST COLLECTORS.

'SIROCCO' PNEUMATIC CONVEYANCE (for local transportation of materials in divided form).

'SIROCCO' AIR CONDITIONING (the proved system for specialised process manufacture and optimum comfort conditions).

Manufactured by :—

Davidson & Co. Ltd., Sirocco Engineering Works, Belfast

LONDON · MANCHESTER · GLASGOW · BIRMINGHAM · CARDIFF · NEWCASTLE · BRISTOL · DUBLIN

RAW MATERIALS—PRICE LIST

(Wednesday, February 8, 1939)

COPPER

	£ s. d.
Standard cash	42 10 0
Three months	42 16 3
Electrolytic	47 10 0
Tough	47 10 0
Best selected	48 0 0
Sheets	78 0 0
India	60 2 6
Wire bars	49 5 0
Ingot bars	49 5 0
H.C. wire rods	52 15 0
Off av. cash, Jan.	43 3 3 9/14
Do., 3 mths., Jan.	43 8 10 11/12
Do., Sttlmnt., Jan.	43 3 5 5/6
Do., Electro, Jan.	48 18 1 1/2
Do., B.S., Jan.	48 15 3 1/2
Do., Wire bars, Jan.	49 7 4 1/2
Solid drawn tubes	12 1/2d.
Brazed tubes	12 1/2d.
Wire	8 1/2d.

BRASS

Solid drawn tubes	11 1/2d.
Brazed tubes	13 1/4d.
Rods, drawn	9 1/2d.
Rods, extd. or rlld.	5 1/4d.
Sheets to 10 w.g.	8 1/4d.
Wire	8 1/2d.
Rolled metal	8 1/2d.
Yellow metal rods	5 1/4d.

TIN

	£ s. d.
Standard cash	213 15 0
Three months	212 10 0
English	213 15 0
Bars	215 15 0
Straits	219 15 0
Eastern	215 7 6
Banca	218 15 0
Off. av. cash, Jan.	215 11 4 3/7
Do., 3 mths., Jan.	216 2 7 1/2
Do., Sttlmt., Jan.	215 11 8

SPELTER

	£ s. d.
Ordinary	13 7 6
Remelted	10 10 0
Hard	9 0 0
Electro, 99·9	17 6 3
English	14 17 6
India	13 10 0
Zinc dust	17 0 0
Zinc ashes	4 12 6
Off. aver., Jan.	13 15 8 3/14
Aver., spot, Jan.	13 13 7 1/2

LEAD

	£ s. d.
Soft foreign, ppt.	14 5 0
Empire (nom.)	15 3 9
English	16 5 0
Sheets, home	22 0 0
Do. export	18 7 6
Pipes, home	21 10 0
Do. export	19 0 0
Tea lead	30 5 0
Off. aver., Jan.	14 12 9 11/28
Aver., spot, Jan.	14 10 8 3/14

ALUMINIUM

Ingots	£94
Wire	1/3 to 1/4 lb.
Sheet and foil	1/2 1/2 to 1/4 lb.

ZINC SHEETS, &c.

Zinc sheets, English 28	5 0 to 28 15 0
Do., V.M. ex-whse. 28	5 0 to 28 15 0
Rods	18 0 0

ANTIMONY

	£ s. d.
English	71 0 0
Chinese, ex-whse.	49 0 0
Crude, c.i.f.	36 0 0

QUICKSILVER

	£ s. d.
Quicksilver	15 13 9

FERRO-ALLOYS AND STEEL-MAKING METALS

Ferro-silicon—	
25%	10 10 0
45/50%	12 10 0
75%	17 0 0
Ferro-vanadium—	
35/50%	14/- lb. Va.
Ferro-molybdenum—	
70/75% carbon-free	4/10 lb. Mo.
Ferro-titanium—	
20/25% carbon-free	9d. lb.
Ferro-tungsten—	
80/85%	4/8 lb.
Tungsten metal powder—	
98/99%	4/9 1/4 lb.
Ferro-chrome—	
2/4% car.	34 15 0
4/6% car.	23 10 0
6/8% car.	23 15 0
8/10% car.	23 5 0
Ferro-chrome—	
Max. 2% car.	36 0 0
Max. 1% car.	38 5 0
Max. 0.5% car.	41 0 0
70% carbon-free	10d. lb.
Nickel—99.5/100%	£180 to £185
"F" nickel shot	£165 0 0
Ferro-cobalt, 98/99%	8/6 to 8/9 lb.
Metallic chromium—	
96/98%	2/5 lb.
Ferro-manganese—	
76/80% loose	£16 15 0 to 17 5 0
76/80% packed	£17 15 0 to 18 5 0
76/80% export (nom.)	£16 15 0
Metallic manganese—	
94/96% carbon-free	1/3 lb.

Per ton unless otherwise stated, basis 2-ton lots, d/d Sheffield works.

SCRAP

	£ s. d.	£ s. d.
South Wales (West)—		
Heavy steel, best	3 0	3 to 3 2 9
Mixed iron and steel	2 18	3 to 3 0 9
Heavy cast iron	3 0	3 to 3 2 9
Good machinery	3 7	0 to 3 10 0
Cleveland—		
Heavy steel, best	2 18	6 to 3 1 0
Heavy cast iron		3 7 6
Heavy machinery		3 12 6
Midlands—		
Short heavy steel		2 17 6
Light cast-iron scrap		2 12 6
Heavy wrought iron	3 0	0 to 3 5 0
Steel turnings	1 17	9 to 2 0 3
Scotland—		
Heavy steel, best	2 16	6 to 2 19 0
Ordinary cast iron	3 15	0 to 3 16 6
Cast-iron borings	1 12	0 to 1 14 6
Wrot-iron piling	3 6	9 to 3 9 3
Heavy machinery	3 17	6 to 4 0 6

London—Merchants' buying prices, delivered yard.

	£ s. d.
Copper (clean)	36 0 0
Brass	20 0 0
Lead (less usual draft)	13 0 0
Tea lead	10 10 0
Zinc	7 10 0
New aluminium cuttings	63 0 0
Braziery copper	31 0 0
Gunmetal	34 0 0
Hollow pewter	145 0 0
Shaped black pewter	105 0 0

HIGH-SPEED TOOL STEEL

Finished bars, 14% tungsten	3s. 0d.
Finished bars, 18% tungsten	3s. 10d.

Per lb. d/d buyers' works.

PIG-IRON*

N.E. Coast (d/d Tees-side area)—	
Foundry No. 1	102/-
" No. 3	99/-
" No. 4	98/-
Forge No. 4	98/-
Hematite No. 1	120/6
Hematite M/Nos.	120/-
N.W. Coast—	
Hem. M/Nos. d/d Glas.	120/6
" d/d Birm.	132/-
Midlands (d/d Birmingham dist.)—	
Staffs No. 4 forge	100/-
" No. 3 fdry.	101/-
Northants forge	97/6
" fdry. No. 3	98/6
" fdry. No. 1	101/6
Derbyshire forge	100/-
" fdry. No. 3	101/-
" fdry. No. 1	104/-
Scotland—	
Foundry, No. 1, f.o.t.	108/-
" No. 3, f.o.t.	105/6
Cleveland No. 3, Glasgow	102/-
" " Falkirk	99/-
Scottish hem. M/Nos. d/d	120/6
Sheffield (d/d district)—	
Derby forge	97/6
" fdry. No. 3	98/6
Lincs forge	97/6
" fdry. No. 3	98/6
W.C. hematite	126/-
Lancashire (d/d eq. Man.)—	
Derby fdry. No. 3	104/-
Staffs fdry. No. 3	104/-
Northants fdry. No. 3	102/6
Cleveland fdry. No. 3	104/-
Glengarnock, No. 3	125/-
Clyde, No. 3	125/-
Monkland, No. 3	125/-
Eglinton, No. 3	125/-
Gartsherrie, No. 3	125/-
Shotts, No. 3	125/-

(* Prices of hematite and basic pig-iron, and of foundry and forge iron with a phosphoric content of not less than 0.75 per cent., are subject to a rebate of 5s. per ton under certain conditions.)

FINISHED IRON AND STEEL

Usual district deliveries.

[A rebate of 15/- per ton for steel bars, sections, plates, joists and hoops is obtainable in the home trade under certain conditions.]

Iron—	£ s. d.	£ s. d.
Bars (cr.)		12 5 0
Nut and bolt iron	10 17 6	to 11 7 6
Hoops		13 12 6
Marked bars (Staffs) f.o.t.		15 5 0
Gas strip		13 12 6
Bolts and nuts, 3/4 in. × 4 in.		—
Steel—		
Plates, ship, etc. (N.E. Coast)	10	10 6
Boiler plts. (N.E. Coast)	11	8 0
Chequer plts. (N.E. Coast)	12	0 6
Angles, over 4 un. ins.	10	8 0
Tees, over 4 un. ins.	11	8 0
Joists, 3 in. × 3 in. and up	10	8 0
Rounds and squares, 3 in. to 5 1/2 in.	11	8 0
Rounds under 3 in. to 1/2 in. (untested)	11	12 0
Flats—8 in. wide and over	10	13 0
" under 8 in. and over 5 in.	10	18 0
Rails, heavy	9	10 0
Fishplates	13	10 0
Hoops (Staffs)	12	7 0
Black sheets, 24g. (4-t. lots)	14	15 0
Galv. cor. shts. (")	17	5 0
Galv. flat shts. (")	17	15 0
Galv. fencing wire, 8g. plain	19	0 0
Billets, soft, 100-ton lots	7	7 6
Sheet bars	7	5 0
Tin bars	7	5 0

PHOSPHOR BRONZE

	Per lb. basis
Strip	11 1/4d.
Sheet to 10 w.g.	11 3/4d.
Wire	13 3/4d.
Rods	13 1/4d.
Tubes	19d.
Castings	15d.

Delivery 3 cwt. free.
10% phos. cop. £33 above B.S.
15% phos. cop. £38 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. CLIFFORD & SON, LIMITED.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1 1/2 to 1/7 1/2
To 15 in. wide	1/1 1/2 to 1/7 1/2
To 18 in. wide	1/2 to 1/8
To 21 in. wide	1/2 1/2 to 1/8 1/2
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3 1/4
Ingots rolled to spoon size	10d. to 1/6 1/2
Wire round—	
to 10g.	1/4 1/2 to 1/11 1/2

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3 1/2 upwards.

AMERICAN IRON AND STEEL

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	22.84
No. 2 foundry, Valley	21.00
No. 2 foundry, Birm.	17.38
Basic, Valley	20.50
Malleable, Valley	21.00
Grey forge, Valley	20.50
Ferro-mang. 80%, seaboard	92.50
O.-h. rails, h'y, at mill	40.00
Billets	34.00
Sheet bars	34.00
Wire rods	43.00
	Cents
Iron bars, Chicago	2.15
Steel bars	2.25
Tank plates	2.10
Beams, etc.	2.10
Skelp, grooved steel	1.90
Steel strip	2.15
Sheets, galv., No. 24	3.50
Wire nails	2.45
Plain wire	2.60
Barbed wire, galv.	3.20
Tinplates, 100-lb. box	$5.00

COKE (at ovens)

Welsh foundry	38/- to 41/6
" furnace	27/6
Durham foundry	34/6
" furnace	24/2
Scottish foundry	30/- to 35/-
" furnace	24/- to 27/6

TINPLATES

f.o.b. British Channel ports

I.C. cokes	20×14 per box		20/3
"	28×20	"	40/6
"	20×10	"	29/-
"	18 1/2×14	"	21/-
C.W.	20×14	"	19/-
"	28×20	"	38/-
"	20×10	"	27/-
"	18 1/2×14	"	19/9

SWEDISH CHARCOAL IRON & STEEL

Pig-iron	£9	0	0 to £10	0	0
Bars-hammered, basis	£19	0	0 to £20	0	0
Bars and nail-rods, rolled, basis	£18	0	0 to £19	0	0
Blooms	£16	0	0 to £17	0	0
Keg steel	£27	0	0 to £30	0	0
Faggot steel	£19	0	0 to £24	0	0
Bars and rods dead soft st'l	£12	0	0 to £15	0	0

All per English ton, f.o.b. Gothenburg
[Subject to an exchange basis of Kr. 19.39 to £1.]

DAILY FLUCTUATIONS

Standard Copper (cash)

			£	s.	d.	
Feb.	2	..	42	17	6 inc.	1/3
,,	3	..	42	16	3 dec.	1/3
,,	6	..	43	3	9 inc.	7/6
,,	7	..	43	1	3 dec.	2/6
,,	8	..	42	10	0 ,,	11/3

Electrolytic Copper

			£	s.	d.	
Feb.	2	..	48	0	0 dec.	5/-
,,	3	..	48	10	0 inc.	10/-
,,	6	..	48	5	0 dec.	5/-
,,	7	..	48	5	0 No	change
,,	8	..	47	10	0 dec.	15/-

Standard Tin (cash)

			£	s.	d.		
Feb.	2	..	215	5	0	dec.	15/-
,,	3	..	215	2	6	,,	2/6
,,	6	..	215	7	6	inc.	5/-
,,	7	..	215	10	0	,,	2/6
,,	8	..	213	15	0	dec.	35/-

Tin (English ingots)

			£	s.	d.		
Feb.	2	..	215	5	0	dec.	20/-
,,	3	..	215	5	0	No change	
,,	6	..	215	10	0	inc.	5/-
,,	7	..	215	10	0	No change	
,,	8	..	213	15	0	dec.	35/-

Spelter (ordinary)

			£	s.	d.		
Feb.	2	..	13	11	3	dec.	1/3
,,	3	..	13	10	0	,,	1/3
,,	6	..	13	12	6	inc.	2/6
,,	7	..	13	11	3	dec.	1/3
,,	8	..	13	7	6	,,	3/9

Spelter (Electro, 99.9 per cent.)

			£	s.	d.		
Feb.	2	..	17	10	0	No change	
,,	3	..	17	8	9	dec.	1/3
,,	6	..	17	10	0	inc.	1/3
,,	7	..	17	10	0	No change	
,,	8	..	17	6	3	dec.	3/9

Lead (soft foreign, prompt)

			£	s.	d.		
Feb.	2	..	14	5	0	dec.	3/9
,,	3	..	14	6	3	inc.	1/3
,,	6	..	14	6	3	No change	
,,	7	..	14	7	6	inc.	1/3
,,	8	..	14	5	0	dec.	2/6

Lead (English)

			£	s.	d.		
Feb.	2	..	16	5	0	dec.	5/-
,,	3	..	16	5	0	No change	
,,	6	..	16	5	0	,,	,,
,,	7	..	16	5	0	,,	,,
,,	8	..	16	5	0	,,	,,

AVERAGE MONTHLY PRICES OF DERBYSHIRE NO. 3 FOUNDRY AT MANCHESTER.

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1903	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6
1904	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6
1905	2 13 0	2 13 0	2 11 6	2 12 6	2 12 0	2 12 0	2 12 3	2 12 3	2 14 0	2 16 6	3 0 0	3 0 6	2 14 1
1906	3 2 0	3 5 0	3 3 0	3 0 6	2 17 0	2 18 6	2 18 0	2 16 6	2 19 0	3 0 6	3 1 6	3 7 0	3 0 8½
1907	3 7 0	3 7 0	3 5 0	3 2 0	3 4 0	3 8 0	3 6 0	3 5 0	3 4 0	3 2 6	3 1 0	2 18 6	3 4 2
1908	2 15 0	2 14 6	2 14 6	2 15 6	2 14 0	2 13 0	2 13 0	2 11 6	2 12 6	2 13 0	2 12	2 12 6	2 13 5½
1909	2 13 0	2 12 6	2 11 6	2 12 0	2 12 6	2 12 6	2 12 0	2 12 6	2 14 6	2 15 0	2 14 6	2 14 0	2 13 0½
1910	2 13 9	2 14 0	2 14 0	2 14 4	2 15 0	2 15 0	2 14 9	2 15 0	2 15 0	2 15 0	2 15 0	2 15 0	2 14 7½
1911	2 16 0	2 16 0	2 16 0	2 16 0	2 16 0	2 16 0	2 16 0	2 16 0	2 16 0	2 14 6	2 15 0	2 15 0	2 15 8½
1912	2 17 4½	2 17 6	2 17 6	3 1 1½	3 2 6	3 3 9	3 6 3	3 7 6	3 10 10½	3 12 6	3 13 3½	3 14 6	3 5 4
1913	3 15 7	3 15 0	3 11 10½	3 11 4½	3 10 2½	3 6 10½	3 4 2½	3 2 9	3 1 9	3 1 0	2 19 3	2 17 2½	3 6 5
1914	2 17 2½	2 18 0	2 18 0	2 17 0	2 17 0	2 16 7½	2 16 0	3 2 10	3 1 0	2 19 9½	2 16 11½	2 18 1½	2 18 2
1915	3 1 2	3 3 11	3 5 9	3 18 8½	3 13 7	3 14 1	3 15 0	3 13 3	3 12 0½	3 11 1	3 14 0	4 3 3	3 12 2½
1916	4 4 6½	4 11 6	4 11 6½	4 7 6	4 7 6	4 7 6	4 10 0	4 12 10	4 12 6	4 12 6	4 12 6	4 12 6	4 8 6½
1917	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6
1918	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6
1919	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6
1920	9 13 9	10 0 0	10 5 3	10 15 3	11 10 0	12 2 6	12 5 0	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	7 3 10
1921	12 11 8	10 8 9	9 2 6	8 2 0	8 0 0	8 0 0	8 0 0	8 1 8	7 4 0	6 7 6	5 7 6	4 1 10	8 0 2
1922	5 5 0	4 17 6	4 15 0	4 15 0	4 12 6	4 12 6	4 12 6	4 11 3	4 10 0	4 10 0	4 10 0	4 13 7½	4 13 7½
1923	4 12 8½	5 0 2	6 2 6	6 8 7½	6 2 5	5 11 9	5 9 1½	5 4 0	5 0 0	5 0 9	5 0 7	5 2 9	5 7 11½
1924	5 3 0	5 3 0	5 3 0	5 3 0	5 2 10	5 1 3	4 17 11	4 15 6	4 13 6	4 10 1½	4 10 0	4 10 3	4 17 9½
1925	4 10 0	4 9 0	4 6 9	4 5 2½	4 3 0	4 0 1½	4 17 1½	3 15 7½	3 14 3½	3 13 4½	3 13 4½	3 13 2½	4 1 9
1926	3 14 9	3 15 3	3 15 6	3 15 3½	3 17 6	4 5 9	4 16 9	•	•	•	•	4 12 6	4 0 1½
1927	4 13 9½	4 13 3	4 11 1½	4 9 4½	4 6 1½	3 19 1½	3 16 1½	3 15 6	3 13 4½	3 13 4½	3 14 0	3 13 6½	4 1 6½
1928	3 13 2½	3 12 3½	3 12 3	3 12 3	3 11 6	3 10 0	3 8 3	3 7 8½	3 7 6	3 7 9½	3 8 3	3 7 6	3 9 10½
1929	3 8 3½	3 10 4½	3 10 10½	3 11 0	3 11 2½	3 12 0	3 12 4½	3 14 6	3 15 1½	3 17 0	3 17 0	3 17 0	3 13 1½
1930	3 17 0	3 17 0	3 17 0	3 17 0	3 17 0	3 17 0	3 15 0	3 12 0	3 12 0	3 12 0	3 10 1½	3 9 6	3 14 4½
1931	3 9 6	3 9 6	3 9 6	3 9 6	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 10
1932	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0
1933	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0
1934	3 7 0	3 9 6	3 13 2½	3 14 0	3 14 0	3 14 0	3 14 0	3 14 0	3 14 0	3 14 0	3 14 0	3 14 0	3 12 11½
1935	3 14 0	3 14 0	3 14 0	3 14 0	3 14 0	3 14 0	3 14 0	3 14 0	3 14 0	3 14 0	3 18 0	3 18 0	3 14 8
1936	3 18 0	3 18 0	3 18 0	3 18 0	3 18 0	3 18 0	4 3 0	4 3 0	4 3 0	4 3 0	4 3 0	4 9 0	4 1 0
1937	4 9 0	4 9 0	4 9 0	4 9 0	4 9 0	4 9 0	5 9 0	5 9 0	5 9 0	5 9 0	5 14 0	5 14 0	4 19 10
1938	5 14 0	5 14 0	5 14 0	5 14 0	5 14 0	5 14 0	5 14 0	5 14 0	5 14 0	5 14 0	5 14 0	5 14 0	5 14 0
1939	5 4 0	—	—	—	—	—	—	—	—	—	—	—	—

NOTE: Prices have been subject to a rebate of 5/- per ton since November 1, 1937. • No prices available during strike period.

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CONTACT desired with Ironfounders and General Engineers requiring the services of a Commercial Engineer of good connections with comprehensive commercial and organising ability, administrative responsibilities, experienced sales control and representation. With active concern advertiser would be prepared to take a financial interest. Details of record, etc., available to principals.—Box 472, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

FOUNDRY FOREMAN or Manager desires change. Practical, technical and business experience; 14 years executive position. At present engaged in foundries taking in all types of general engineering castings, mechanised plant, high-duty and alloy irons, non-ferrous. Fully capable of taking entire charge and guarantee results.—Box 470, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

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FOREMAN for jobbing iron foundry near London. Please state experience and wages required.—Box 486, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

FOREMAN required for brass foundry producing pressure castings; knowledge of machine moulding, reverberatory furnaces and electric furnaces required. Applicants must give full details of experience, previous posts occupied, age, and salary required to: Box 474, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

WANTED.—Young Man for Cupola Control; knowledge of metallurgy required. To a suitable man the post will be a progressive one. State experience, age, and salary required to: Box 476, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

SITUATIONS VACANT AND WANTED—*Contd.*

WANTED.—Reliable working Charge Hand for small country jobbing foundry, 30 miles from London. Competent to control cupola. State age, experience, and wages required.—Box 480, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

WANTED.—Experienced Chemist for a Midlands Laboratory for routine tests on alloy and high-duty cast irons. Full details of experience, age, and salary in confidence to: Box 456, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

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Conducted by the Institute of British Foundrymen by courtesy of the proprietors of THE FOUNDRY TRADE JOURNAL.

Correspondence should be addressed to the General Secretary, Institute of British Foundrymen, St. John Street Chambers, Deansgate, Manchester,, from whom full particulars can be obtained of this service.

Any employer wishing to communicate with a candidate should write to the General Secretary, quoting identification number.

FOUNDRYMAN requires situation. Competent to control cupolas, metal mixtures and sand plant on modern lines. Experienced continuous casting and general, light castings and engineering, coreshop, etc. (347)

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Low price loaded on rail to save second removal.

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12 Plain Squeeze and Turnover Machines by Bonvillain.

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Ditto, 2¼-in. rams.

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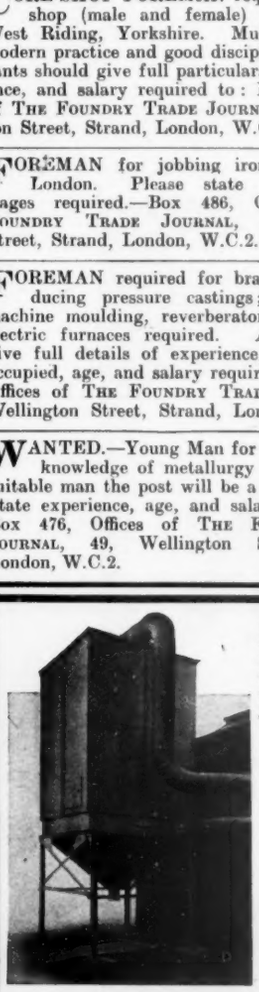

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